Aviation Week and Space Technology

A McGraw-Hill Publication

25 Cents

September 12, 1960

SPECIAL REPORTS:

Pioneer VI Aims At Lunar Orbit

•

Civilian HU-1B

Grumman AO-1 Mohawk In Maximum Performance Takeoff

Kaylock Anchor Nuts being fastened to aft engine cowl ring of Hound Dog at Missile Division of North American Aviation, Inc., Downey, Calif.

ONE OF KAYNAR'S BEST FRIENDS IS THE HOUND DOG

The GAM-77 Hound Dog and the B52G bomber are very much attached to each other, since the air-to-surface missile's power plant can be used to augment the mighty power thrust of the mother bomber's eight engines. Kaynar is attached to both craft, in more ways than one! Miniature Kaylock (r) lightweight, self-locking nuts are used extensively on the supersonic Hound Dog and the Boeing long range bomber from which it is launched. Now operational, North American Aviation's Hound Dog adds an even greater deterrent force to the might of SAC.

Kaynar, originator of the lightweight, self-locking nut, continually joins forces with great leaders in aerospace design, offering them access to the world's largest, most complete line of miniature fasteners. Send for the new Kaylock Miniature Catalog today... or if you have special locknut problems, call your nearest Kaynar representative.

KAYNAR MFG. CO., INC., KAYLOCK DIVISION
Box 2001, Terminal Annex, Los Angeles 54, Calif. Branch offices, warehouses & representatives in Wichita, Kansas; New York, N.Y.; Atlanta, Ga.; Renton, Wash.; Montreal; Paris; London; The Hague

Kaylock.
first in lightweight locknuts

Electronic countermeasures

SYSTEMS SIMULATION: a GAC specialty

Complete Weapon System Training Capability *– from part-task trainers to system trainers – can be obtained at Goodyear Aircraft Corporation (GAC). Here, where the development of effective training devices is achieved, you'll find the engineering skills to design and build tactics trainers, flight trainers, maintenance trainers, and integrated weapon system trainers. Emphasis throughout is on* practical *realism and the latest concepts in biomechanical engineering. This includes many special effects such as visual simulation, which GAC has brought to a high degree of refinement. Whatever your training device needs – whether for aircraft, missiles, space vehicles – GAC has the* experience, *and the* facilities, *to fill* any *military requirement. Goodyear Aircraft Corporation, Dept.* **916AU, Akron 15, Ohio.**

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Plants in Litchfield Park, Arizona, and Akron, Ohio

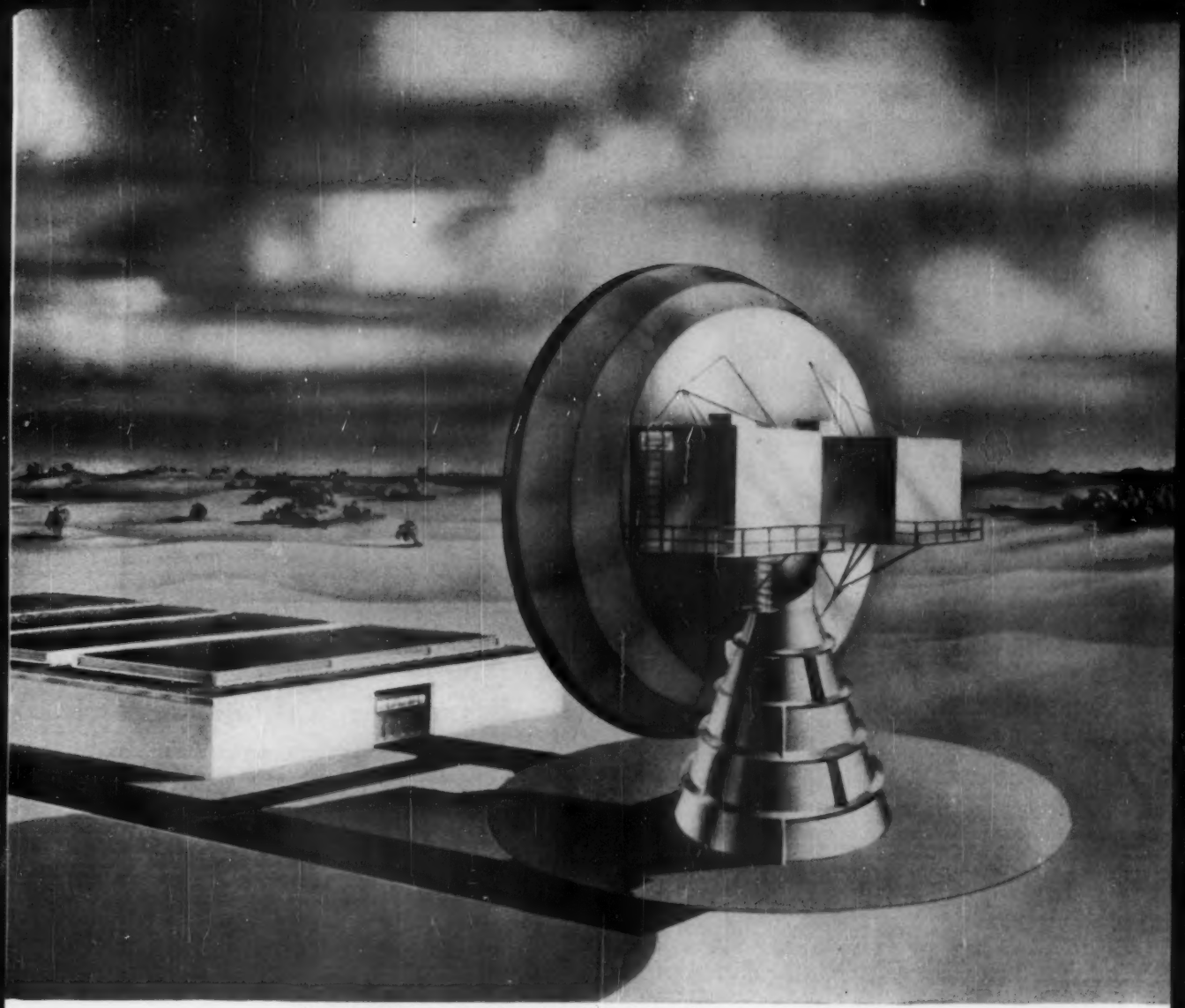
providing all 3 weapon system skills

DESIGN

MANAGEMENT

Classroom trainer, radar target generator – also available at GAC

Mobile flight simulator – built by GAC for Navy



Five-story high antenna for Pincushion radar will be part of a new Advanced Research Projects Agency installation to be set up in mid-Pacific.

A unique radar designed to track and identify the warhead of ICBMs thousands of miles away is now being developed by Raytheon, under the direction of Rome Air Development Center.

Designated "Pincushion", because of its microwave beam pattern formation, the 80-ton Raytheon radar will be part of Project Defender, ARPA's program to develop advanced anti-ICBM concepts.

RAYTHEON COMPANY, WALTHAM, MASS.

RAYTHEON

EXCELLENCE IN ELECTRONICS

AVIATION CALENDAR

Sept. 12-14—Fourth Annual Meeting, Human Factors Society, Kresge Auditorium, Massachusetts Institute of Technology, Cambridge, Mass. Host: The Mitre Corp.

Sept. 19-22—National Symposium on Space Electronics and Telemetry, IRE, Shoreham Hotel, Washington, D. C.

Sept. 20-22—13th Annual Meeting & Forum, National Business Aircraft Assn., Ambassador Hotel, Los Angeles, Calif.

Sept. 21-25—National Convention and Aerospace Panorama, Air Force Assn., Civic Auditorium and Brooks Hall, San Francisco, Calif.

Sept. 24—Reunion, 1st Air Commando Group, concurrent with AFA Convention. Contact: Lt. Col. R. E. Moist, USAF, 7025 Hayvenhurst Ave., Van Nuys, Calif.

Sept. 25-27—24th Annual Convention, International Northwest Aviation Council, Harrison Hot Springs, British Columbia.

Sept. 27-30—Space Power Systems Conference, American Rocket Society, Miramar Hotel, Santa Monica, Calif.

Sept. 28-30—Conference on Solid State Nuclear Particle Detectors, Asheville, N. C. Sponsors: Air Force Office of Scientific Research; National Academy of Sciences.

Oct. 1—Second Annual Fly-In for General Aviation, National Aviation Facilities Experimental Center, Atlantic City, N. J. Sponsor: Federal Aviation Agency's Bureau of Research and Development.

Oct. 2-10—Federation Acronautique Internationale Annual Meeting, Barcelona, Spain.

Oct. 3-5—Sixth National Communications Symposium, IRE, Utica, N. Y.

Oct. 3-5—Seventh Annual Meeting, Institute of Radio Engineers' Professional Group on Nuclear Science, Gatlinburg.

(Continued on page 6)

AVIATION WEEK and Space Technology

September 12, 1960

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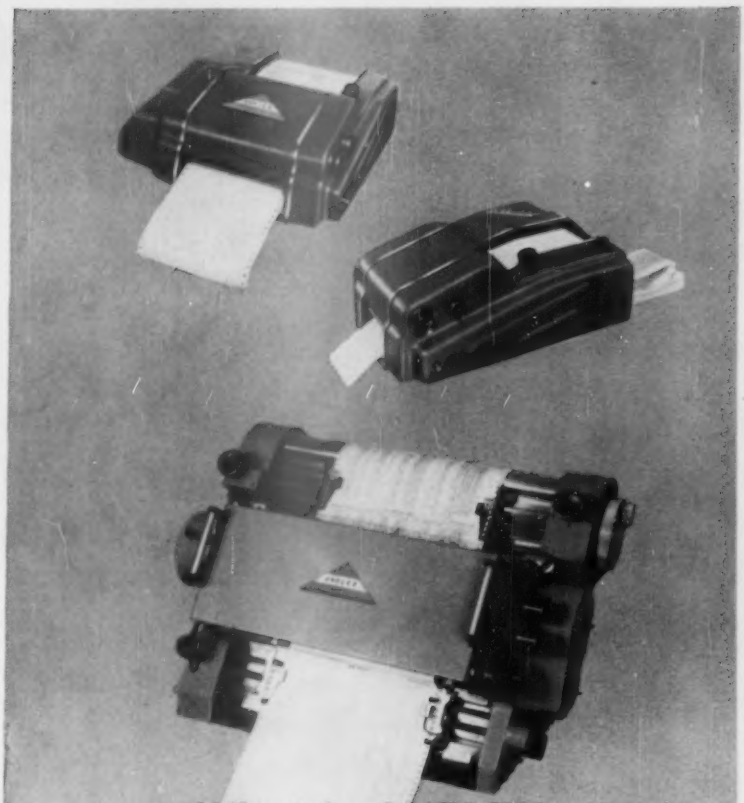

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Anelex High Speed Printers print from magnetic tape or "on-line" from data processing systems . . . on single or multiple carbons, pressure sensitive papers, heat transfer type papers, preprinted forms or card stock. All Operator Controls are easily manipulated by office personnel without specialized experience or skills.

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Proven high sheet clamp-up—one rivet can be used for several material thicknesses, reducing stock requirements and lowering cost. Complete hole fill even in oversize holes, with uniform head seating, wide grip range and mechanically locked stem.

Easy, positive visual inspection—after the rivet is installed—is guaranteed by grip length markings on the head. Cherrylock rivets are installed with existing Cherry installation guns to give you better fastening at lower cost.

Available in:

A-286 Stainless Steel
Monel—Aluminum.

For technical data on the new Cherrylock "2000" Series rivets, write Cherry Rivet Division, Townsend Company, Box 2157-N, Santa Ana, Calif.

* *Patent No. 2931532*

CHERRY RIVET DIVISION
SANTA ANA, CALIFORNIA
Townsend Company
ESTABLISHED 1816 • NEW BRIGHTON, PA.
In Canada: *Parmenter & Bulloch Manufacturing Company, Limited, Gananoque, Ontario*

AVIATION CALENDAR

(*Continued from page 5*)

Tenn. Cosponsor: Oak Ridge National Laboratory.

Oct. 3-5—National Midwestern Conference on Air Logistics, Institute of the Aeronautical Sciences, Tulsa, Okla.

Oct. 3-5—First International Air Traffic Control Conference and Fifth Annual Meeting of the Air Traffic Control Assn., Sheraton-Palace Hotel, San Francisco.

Oct. 4—13th Annual New York State Aviation Development and Operation Conference, Hotel Onondaga, Syracuse, N. Y.

Oct. 4-6—Sixth Conference on Radio Interference Reduction, Chicago, Ill. Sponsors: Armour Research Foundation; U. S. Army; U. S. Navy; USAF; IRE.

Oct. 5-7—Briefing Session on Opportunities in Space-Age Technology, American Management Assn., Hotel Astor, New York, N. Y.

Oct. 6-8—Annual Convention, Airmail Pioneers, El Cortez Hotel, San Diego, Calif.

Oct. 6-8—Society of Experimental Test Pilots Symposium on "Omni-sonic Flight," Ambassador Hotel, Los Angeles, Calif. Fourth Annual Awards Banquet, Oct. 8.

Oct. 6-9—Annual Meeting, National Pilots Assn., Western Hills Lodge, Wagoner, Okla.

Oct. 8—Third Annual National Aero Club Football Fly-in, Michigan vs. Duke, Ann Arbor, Mich.

Oct. 10-12—1960 National Electronics Conference and Exhibition, Hotel Sherman, Chicago, Ill.

Oct. 10-14—Society of Automotive Engineers National Aeronautic Meeting, Ambassador Hotel, Los Angeles, Calif.

Oct. 12-14—Third AFOSR Astronautics Symposium, Ambassador Hotel, Los Angeles, Calif. Sponsors: Air Force Office of Scientific Research; Society of Automotive Engineers. (Open Meeting.)

Oct. 14-15—Symposium on High-Speed Processing, Society of Photographic Scientists & Engineers, Washington, D. C.

Oct. 14-15—15th Midwest Conference, American Society for Quality Control, Broadview Hotel, Wichita, Kan.

Oct. 17-18—Joint Meeting, Institute of the Aeronautical Sciences and Canadian Aeronautical Institute, Queen Elizabeth Hotel, Montreal, Canada.

Oct. 17-21—National Safety Council's 48th National Safety Congress, Conrad Hilton Hotel, Chicago, Ill.

Oct. 19-21—Annual Convention, Southeastern Airport Managers' Assn., Far Horizons Motel, Sarasota-Bradenton, Fla.

Oct. 19-21—Symposium on Space Navigation, Institute of Radio Engineers, Deshler-Hilton Hotel, Columbus, Ohio.

Oct. 19-21—Annual Meeting, Society for Experimental Stress Analysis, Hotel Claremont, Berkeley, Calif.

Oct. 20-21—National Symposium on Hypervelocity Techniques, Institute of the Aeronautical Sciences, Shirley-Savoy Hotel, Denver, Colo.

Oct. 24-26—Medical and Biological Aspects of the Energies of Space, Unclassified Symposium, Granada Hotel, San Antonio, Tex. Sponsored by the School of Aviation Medicine. Arranged by Southwest Research Institute.

Raytheon activates industry's first center for Anti-Submarine Warfare, Portsmouth, R. I.

Now functioning, Raytheon Submarine Signal Operations' new ASW Center designs, develops and produces complete systems for detection-through-destruction of objects in *hydrospace* (ocean depths and interface). Sub-systems embrace: torpedo guidance and location devices; sonar and mine countermeasures; communications, IFF, oceanographic equipments.

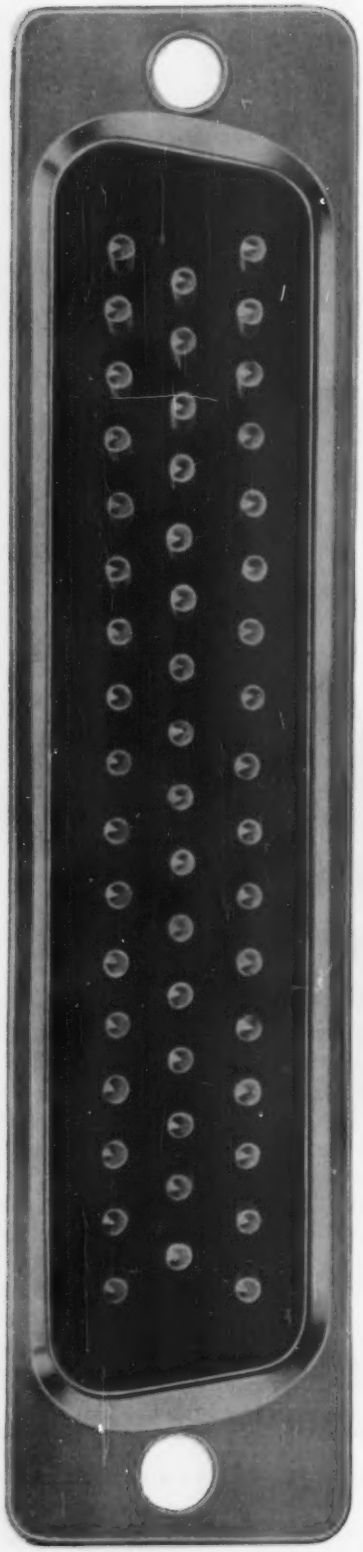
Among unique Center facilities are: 180,000 gallon "L"-shaped acoustic tank; Alan, fully-equipped 65 ft. mobile sonar test boat; acoustic pressure tank up to 6000 psi.

Current programs provide for 3D omni or highly directional submarine, air, and ship-borne sonars; trainers; listening and measuring devices. Past advances effected by this Raytheon capability include: first fully hull-integrated comprehensive detection system — for Navy's nuclear-powered hunter-killer submarines; transistorized deep-dip airborne sonar; first helicopter-borne echo ranger; non-interfering sonar trainers. We believe location, facilities, and capability make this the nation's primary industrial center for ASW research, advance development, engineering, and production.

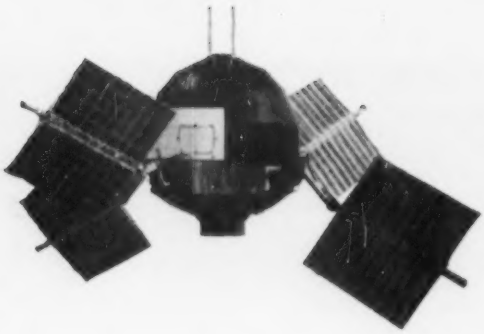
RAYTHEON EQUIPMENT DIVISION

Excellence in Electronics

For Raytheon ASW Capabilities Brochure,
Write: Director of Marketing, Equipment Division, Dept. B1, Raytheon Company, West Newton, Mass.



THREE AND ONE-HALF TIMES ACTUAL SIZE



CANNON GOLDEN-D SUBMINIATURE PLUGS

DESIGNED ESPECIALLY FOR MISSILE CIRCUITRY AND MAXIMUM RELIABILITY APPLICATIONS

The "Golden-D" Cannon Plugs are engineered to deliver superior performance in a subminiature size! Supplementing our famous standard D-Subminiature line, the "Golden-D" has these new design features: • MONOBLOC INSULATORS • PROBE-PROOF CLOSED-ENTRY SOCKET CONTACTS • LOW ENGAGEMENT/SEPARATION FORCES • GOLDEN CADMIUM SHELL FINISH • MATES WITH ANY CANNON "D" OF SAME SIZE AND LAYOUT. Wherever maximum reliability is needed in a subminiature multi-contact plug—for both military and industrial applications—ask for the new "Golden-D"!...another reason why you should contact the world's most experienced plug manufacturer for *all* your plug requirements. The "Golden-D" is available in four types with a large variety of contact layouts. For further information write to:

CANNON ELECTRIC COMPANY, 3208 Humboldt St., Los Angeles 31, Calif.

CANNON PLUGS

W. M. Willis, Chief Engineer of Marman Division, displays some of the many couplings and joints developed by Marman engineers.

MARMAN

Leads in Joint and Coupling Engineering

Pictured at the left are a few of the many V-Band Couplings and Joints designed and produced by Marman for every aircraft and missile application. Marman V-Band Couplings are ideal for connecting all sizes of tubing, piping and ducting used in fluid transfer and structural applications. The lightweight Marman J13 V-Band Joint provides efficient sealing for pneumatic and hot air or gas lines. The J11 V-Band Joint may be used for fluid systems. Marman high-performance CONOSEAL Joints provide a leakproof seal where zero leakage is required over a wide temperature range.

Call on Marman's 20 years of experience when you have a joint or coupling problem. Highly skilled and experienced engineers are ready to be of assistance to you. Also send for the new Marman Catalog No. 800 showing hundreds of joints available from stock.

CONOSEAL is an Aeroquip Trademark

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MARMAN DIVISION

11214 Exposition Blvd., Los Angeles 64, California

Joints, V-Band Couplings and Flanges, Fuel and Hot Air Couplings, Band Clamps, Instrument Clamps, Bellows, Ducting, and Universal Joints.

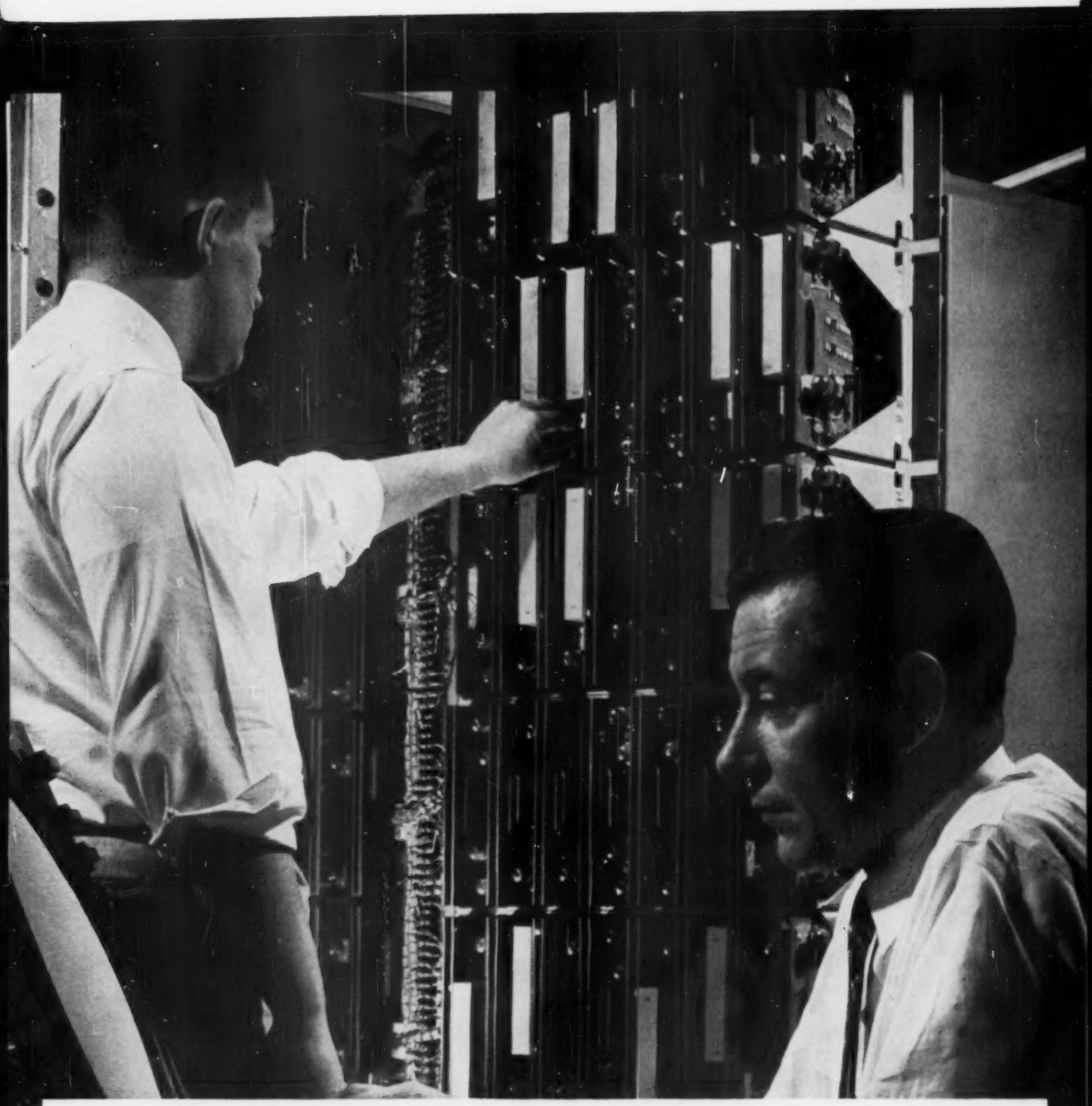
A WIDE PERFORMANCE RANGE IS POSSIBLE THROUGH DIFFERENT FLANGE AND GASKET DESIGNS AS ILLUSTRATED

Standard V-Band Couplings and flanges for high-strength structural connection of components and tubing, choice of solid or formed flanges.

J13 Joints provide a lightweight connection for standard and thin wall tubing where low leakage rate is permissible.

J11 Joints for fuel connections where zero leakage is not required, as well as leak, air and gas lines for temperatures up to 1200° F., pressures to 4000 psig.

CONOSEAL Joints provide zero-leakage connection of tubing and piping over temperature range of —423° F. to +2000° F., pressures to 20,000 psig.



AN ACHIEVEMENT IN DEFENSE ELECTRONICS

AN/FSA-12--First to detect and process 3-D radar data automatically

The first equipment to successfully automate the processing of three-dimensional data direct from a working radar, the AN/FSA-12 (XW-1) has operated since 1958. This detector tracker has enabled General Electric to develop many improved radar techniques and equipment.

New concepts in correlation and smoothing in the track-while-scan method have been demonstrated. Delay lines applied to digital techniques and plug-in wiring boards have been improved. New ideas in data storage and digital circuitry have been applied.

This experimental model continues to be a proving ground in research and development of advanced military electronics. A completely solid state production version of the AN/FSA-12 will soon be available for many of our nation's air defense radar sites. 176-04

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DEFENSE ELECTRONICS DIVISION
HEAVY MILITARY ELECTRONICS DEPARTMENT • SYRACUSE, NEW YORK

GENERAL ELECTRIC

FOR RELIABILITY UNDER SHOCK LOADS AND HIGH HEAT...SPECIFY MIDVAC STEELS

Where metal parts must stand the sudden shock of heavy loads, as on plane landing gears . . . or the high heat of jet engines Midvac Steels offer the answer. The Midvac Process of consumable electrode vacuum melting produces metals with increased tensile, higher impact properties, improved stress rupture strength at elevated temperatures, and longer fatigue life.

Midvac Steels are offered in many alloys (some are shown in table below) as billets or forgings for the production of forgings to meet the most critical design specifications of today's space age. Complete details on Midvac Steels, plus comparative analysis of leading super alloys are available in new Midvac Steel Booklet. Write for your copy to . . .

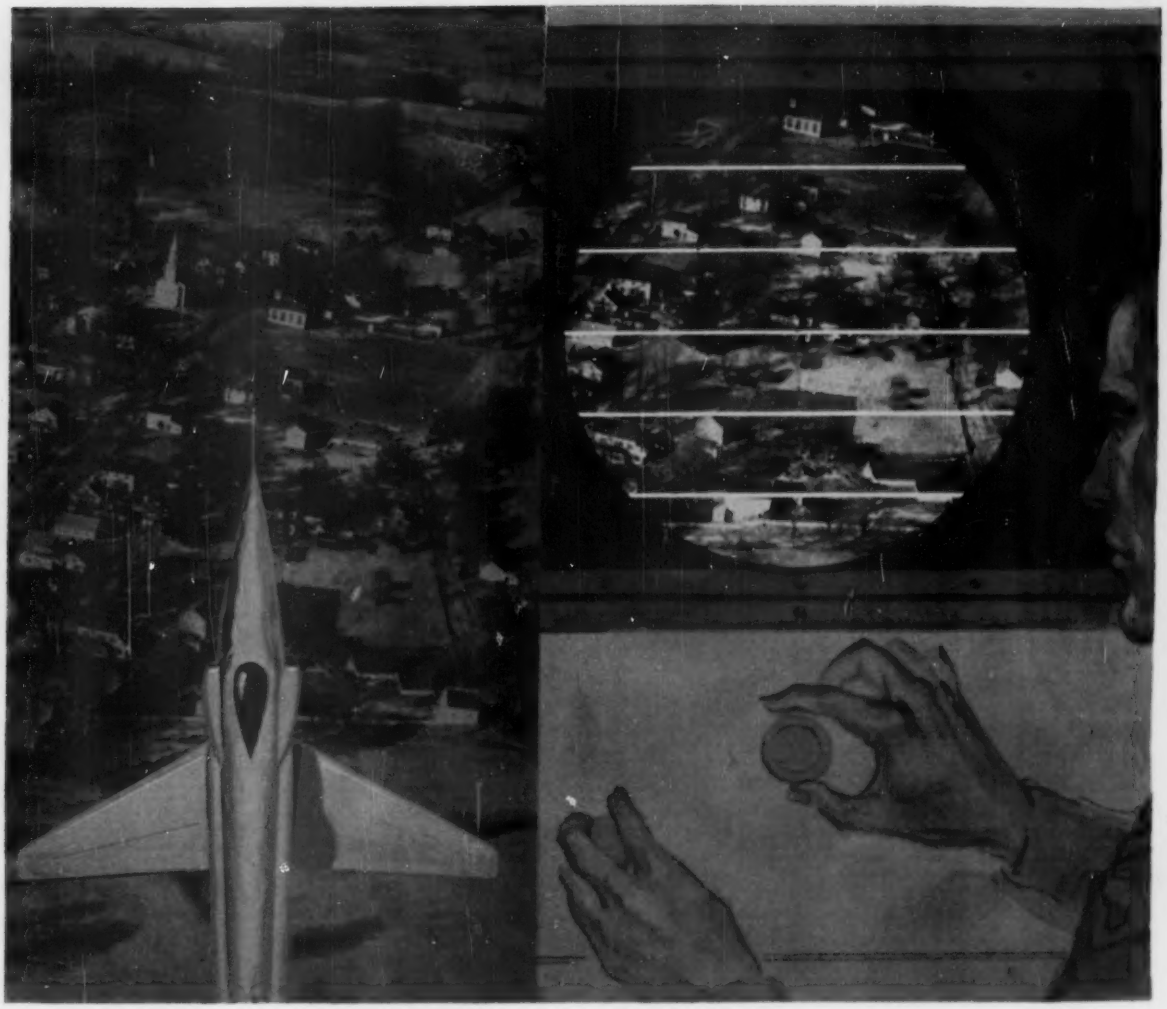
MIDVALE-HEPPENSTALL COMPANY

Subsidiary of Heppenstall Company, Pittsburgh, Pa. **NICETOWN, PHILADELPHIA, PA.**

Alloy	Melting Process	Yield Strength .2	Ultimate Tensile Strength	Percent Elongation	Percent Reduction of Area
A-286	Air Melt	99,000 psi	132,300 psi	9.0%	14.7%
	Midvac	117,000 psi	150,500 psi	21.3%	33.8%
D6A-C	Air Melt	234,800	281,000	4.9%	20.6%
	Midvac	256,700	294,250	9.6%	28.4%
Tricent	Air Melt	238,600	284,500	6.1%	19.7%
	Midvac	254,300	291,600	10.3%	25.6%
901 Regular	Midvac	116,000	160,000	18.0%	25.0%
901 Hi-Strength	Midvac	131,000	179,000	19.2%	20.2%

Properties shown are averages of 25 heats

MH Midvac Steels



Automated accuracy in aerial mapping

By utilizing the tireless eye of a television camera boresighted to the optical axis of the aerial camera, Norden has eliminated manual use of an optical viewfinder. The operator on his six-inch TV screen sees the same terrain that his camera is photographing. His field of vision is enlarged over other current systems, while eyestrain and fatigue are drastically reduced.

Since aerial photography for mapping demands exacting control of overlap with perfect alignment of cameras and the aircraft's ground track, Norden engineers developed this computer-controlled system, for and in cooperation with Wright Air Development Division. Now the operator sets the required percentage of overlap between successive photographs, and synchronizes terrain speed with horizontal signal lines displayed in the TV picture. Once synchronized, operation of the camera shutter is automatic . . . and more accurate than ever before.

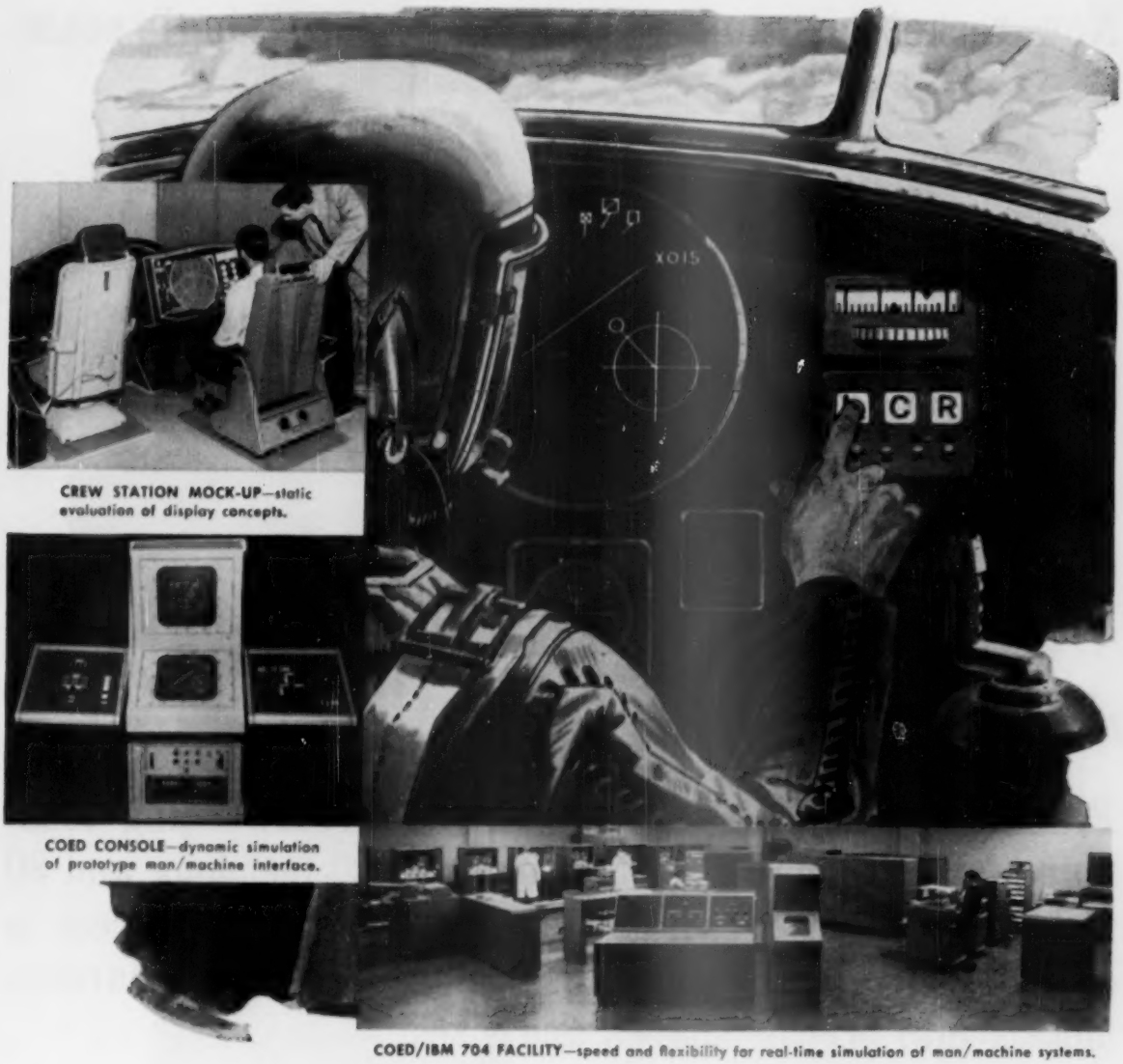
This Overlap Control Computer Set is another example of Norden's engineering capabilities, particularly notable in the design, development and manufacture of military TV, digital computing and digital control systems. Progress at Norden is measured by the degree to which each idea, each job, each product contributes to the Norden goal . . . extending man's capabilities.

• • •

Stimulating positions are available at all levels of responsibility for qualified engineers and scientists.

NORDEN

NORDEN DIVISION
UNITED AIRCRAFT CORPORATION
STAMFORD, CONNECTICUT



CREW STATION MOCK-UP—static evaluation of display concepts.

COED CONSOLE—dynamic simulation of prototype man/machine interface.

COED/IBM 704 FACILITY—speed and flexibility for real-time simulation of man/machine systems.

COED . . . computer operated electronic display

The airborne data processing system for the EAGLE missile concept uses advanced digital data handling complemented by the intelligence of the human operator. Coordinated transfer of data between man and machine is implemented with human-factored electronic display and control devices.

Balanced man and computer functions are assured in the development of the EAGLE electronic system through analysis and experimentation with realistic operational missions using the COED (Computer Operated Electronic Display) simulator. This simulation involves real-time programs for a large-scale digital computer which are integrated with cathode-ray-tube alpha-numeric displays and operator controls.

The COED system has been developed to provide a special facility for versatile and realistic simulations of the man-machine interface. It is a stepping stone in the Bendix program of *Intellectronics* where the ultimate goal is the machine synthesis of man's unique perceptual and intellectual faculties.

Opportunities are available to better engineers and scientists who would like to participate in this and other systems programs of the highest technical integrity.

Bendix Systems Division

ANN ARBOR, MICHIGAN

Now, rocket cases up to 20 feet without a single seam

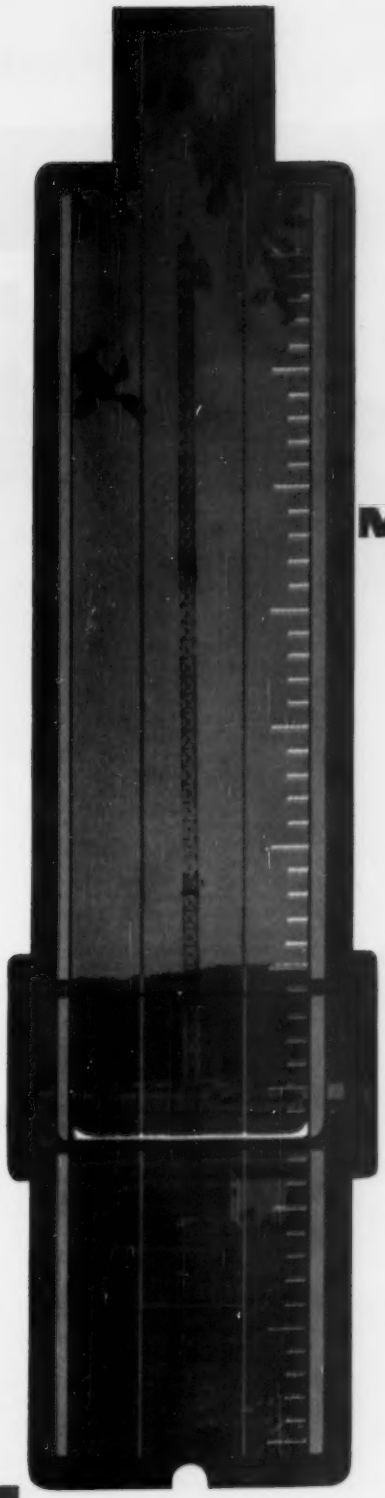
Pratt & Whitney Aircraft now has a metalworking technique for producing rocket cases up to 20 feet long and 80 inches in diameter—without a single weld. The process is called flow-turning. It spreads and forms even the hardest metals into precise shapes and sizes.

Seamless, flow-turned rocket cases and jet engine parts are stronger, lighter and more economical to produce than welded parts. Moreover, the process of flow-turning itself increases the metal's tensile strength.

Flow-turning is among the many advanced precision manufacturing skills that Pratt & Whitney Aircraft engineers have pioneered and refined. It plays an important role in the design and development of dependable power for flight.

Pratt & Whitney Aircraft

EAST HARTFORD, CONNECTICUT/A DIVISION OF UNITED AIRCRAFT CORPORATION



VERSATILE METAL FABRICATION

. . near Southwestern electronics and airframe manufacturers

In the center of the Southwestern complex of space-age activity is Continental-Emsco's huge steel fabricating facility. This versatile plant covers 77 acres . . 366,505 sq. ft. under roof. It's complete with machining, boring, milling, and turning equipment, spacious fabricating bays and creative staffs for engineering and Research & Development. Quality-control measures meet MIL-Q-9858 standards.

Versatility to handle any metalworking job is evidenced by this plant's production of propellant trucks, rocket launchers, crane trucks, marine gears, cargo winches, airframe parts, towers, and a complete line of oil field equipment. Illustrated is a typical 700′ triangular tower built by Continental-Emsco.

Get Continental-Emsco's quotations on your next equipment contract.

METAL FABRICATORS FOR INDUSTRY

CONTINENTAL-EMSCO COMPANY

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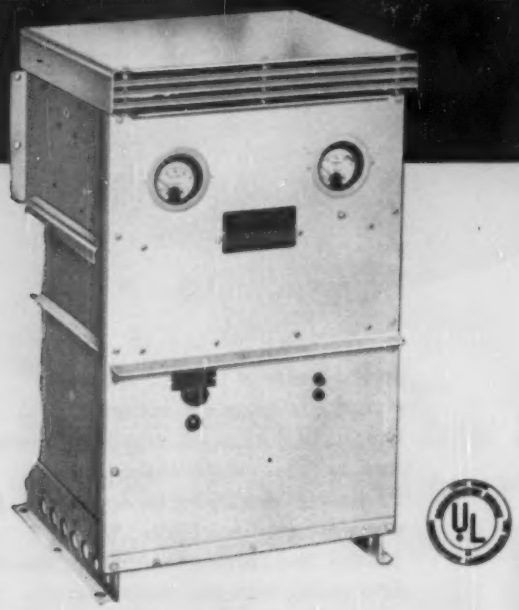

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- All Silicon
- Built to MIL-E-4970
- Overload and Short Circuit Protection
- 500% Overload Capability

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3420 W. 67th Street, Los Angeles 43, California

300 AMP. POWER SUPPLY

Model MH32-300KP4

Electrical Specifications:

NOMINAL D-C OUTPUT:
28 v. @ 300 amp. (continuous)

VOLTAGE ADJUSTMENT RANGE:
22 to 32 v. d-c

VOLTAGE REGULATION:
±0.5% — combination of rated load and a-c input variations (Sensing: local or remote)

VOLTAGE RIPPLE:
1% rms. (−20°C to +55°C)

VOLTAGE RECOVERY (63%):
0.1 sec.— full load application or removal

D-C CURRENT OVERLOAD CAPACITY:
125% for 5 min. every 20 min.
250% for 5 sec. every 20 sec.
350% for 1 sec., 500% peak

A-C INPUT:
400-490 v., 3-ph., 57-63 cps.
(other voltages available)

A-C CURRENT AT 440 V.:
25 amp.

AMBIENT TEMPERATURE RANGE:
Operating: −55°C to +55°C
Storage: −62°C to +70°C

ENVIRONMENT, SHOCK, VIBRATION:
Built to MIL-E-4970

RADIO INTERFERENCE:
Built to MIL-I-26600

Mechanical Specifications:

CABINET STYLE: STATIONARY
Also other styles below

SIZE & WEIGHT:
19" W x 19" D x 31" H.— 355 lbs.

Standard Features:

VOLTMETER & AMMETER:
3½" ruggedized (MIL-M-10304)
Recessed behind removable panel

OVERLOAD PROTECTION:
Magnetic & thermal

PARALLEL OPERATION:
Includes load sharing provision

OTHER FEATURES:
Input Contactor, Pilot Light, Fan, Fan Failure Protection.

Over 200 Models in 6 Cabinet Styles

Stationary | 19" Rack | 2-Wheel | Caster | Lab Cabinet | 3-Wheel

First transistorized fuel control for turbine engines, developed by Sperry.

for advanced turbojets and turboprops

Electronic Engine Control by SPERRY

Designed for the high performance turbojet and turboprop powerplants of today—and tomorrow—this experimental Engine Control performs all sensing and computation functions electronically for precise control of fuel flow.

This revolutionary system, developed in cooperation with Continental Aviation & Engineering Corporation, eliminates complicated hydro-mechanical computing elements. Sensing engine speed, inlet temperature, and turbine discharge temperature—using highly reliable solid state computing devices—this control provides isochronous speed regulation without surge or overtemperature.

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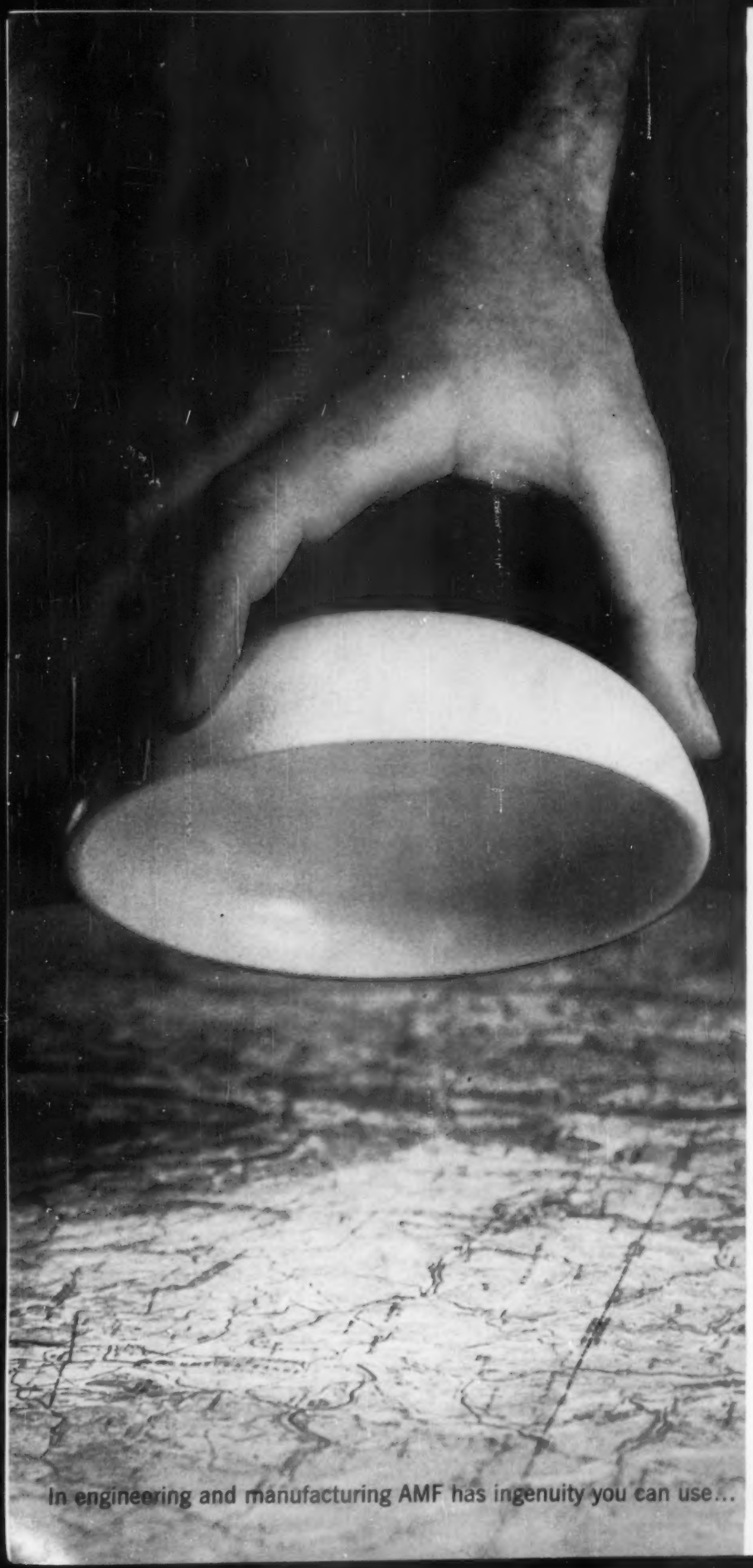

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September 12, 1960

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PICTURE CREDITS

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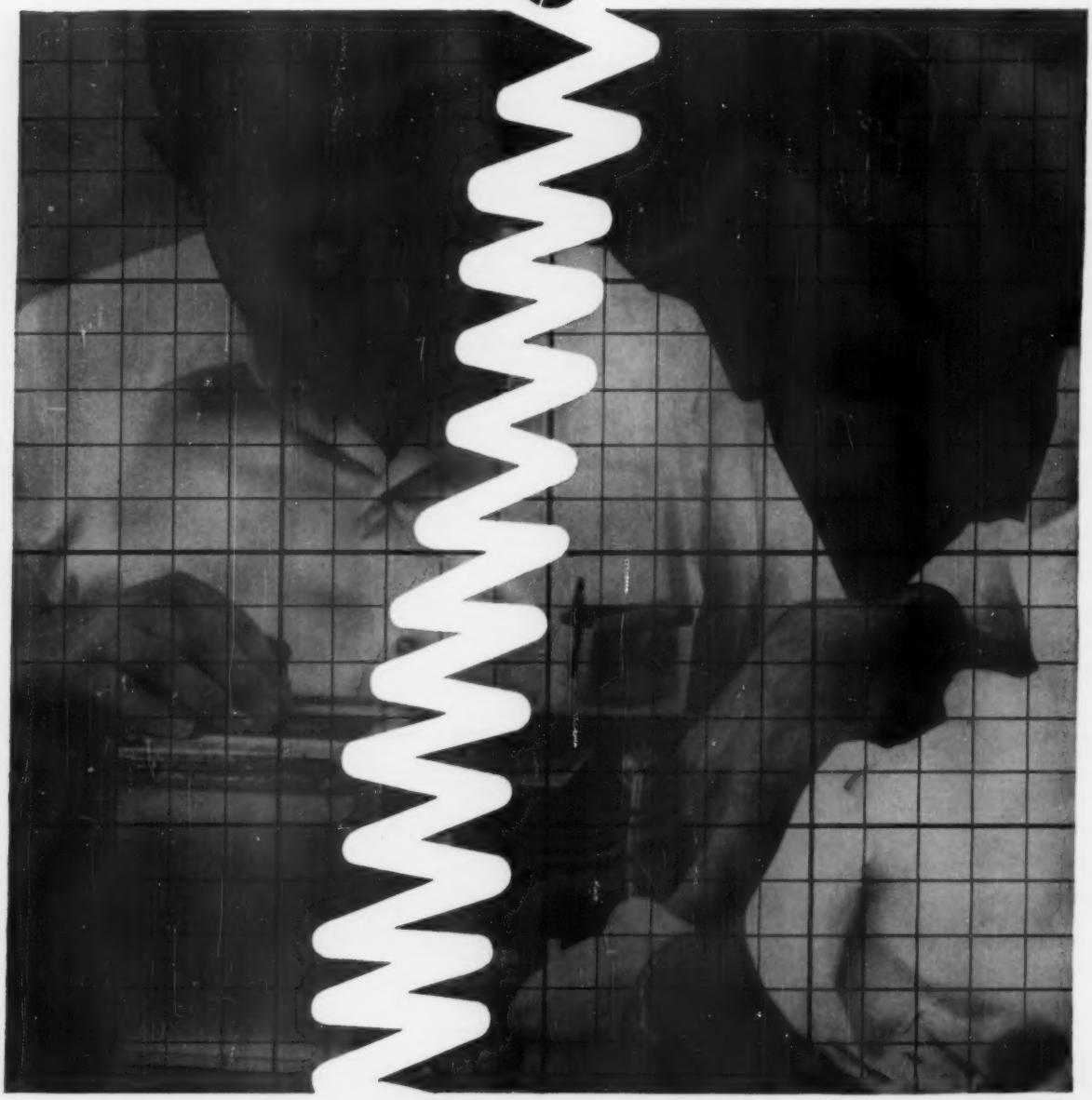

EDITORIAL

Reflections From Farnborough

The sleepy little town of Farnborough that annually blossoms for a week as the Mecca of aviation people the world over has always provided a good vantage point from which to view the current status of the British aircraft industry—an industry that has provided the toughest competition for U.S. aviation products in international markets and even establish a beachhead of transport sales in our domestic market.

This year finds the British industry at the bottom of a noticeable trough in technical development, marking a petering out of development trends of the fifties. Britain's industry also is in a state of economic and personal shock over the shotgun wedding mergers of the past year that were designed to weld industrial giants with sufficient technical and financial resources to maintain the competitive pace and leave just enough of these combinations to maintain a healthy domestic competition.

Basically, the British aircraft industry has now shaken down into two huge airframe corporations—the Hawker Siddeley Group and the British Aircraft Corp.; two engine firms—the Bristol Siddeley combine and redoubtable Rolls-Royce, still breaking its own technical ground and impervious to any regrouping of the industry; and a single helicopter firm: Westland. Organizationally, this should strip the British industry down to where it can again climb to the competitive heights it scaled in the early fifties before slipping so badly in the final half of that decade.

However, although the organizational aspects of these mergers have been completed there remains considerable dogged spade work and hard-headed weeding in the ever blossoming garden of British prototypes before these new groups can channel their resources toward the major competitive goals of the coming decade.

Enthusiasm Lacking

Inevitably the compressing effect of these mergers on technical personnel and the meager display of competitive hardware on the counter at Farnborough this year have combined to dull the sharp enthusiastic edge that has generally characterized Farnborough week in England. This is reflected in the listless piloting of the venerable designs. Not even the recall of such virtuosi of Farnboroughs past as Beamont, Neville Duke, Bill Waterton and Roly Falk could make the Hunter, Javelin, Sea Vixen and Lightning appear exciting at this late date.

British newspapers who used to scream on page one every day of Farnborough week of some new detail in which British aviation allegedly led the world have buried the story inside with small paragraphs. Even Maj. Oliver Stewart, whose breathless enthusiasm announcing the flying display over the public address system is traditional, sounded a bit jaded this year. Our distinguished British contemporary, Flight magazine, noted that orders for British equipment are not appearing as hoped and settled for a warning that the British industry is aiming to stay in the international competition. An exception to the dull character of the flying display must be noted in the valedictory performances of the Royal Air Force's Treble One Squadron whose Hunter techniques have written a permanent chapter in the history of aerobatics. At this Farnborough, as always, they were simply superb.

The mergers have given rise to some gloomy jokes, such as translating the traditional Society of British Aircraft Constructors (SBAC) into Society of Both Aircraft Constructors with the prospect of evolution into the Single British Aircraft Constructor. Underneath this understandable reaction to the impact of change on traditional patterns there is discernible a flow of new technical currents that may turn the tide. The British aircraft industry has always made major technical contributions and this has never been where its principal problems lay.

Rather they have been in the area of spreading its talents too thin over too wide a variety of projects; of becoming too satisfied with prototype achievement and dallying too long in pushing production programs of operational aircraft, and in failing to perceive the revolutionary post-war changes in both military and commercial aviation markets of the world.

Industry's Problems

The technical brains of the British aircraft industry are already well along on a variety of promising future developments in VTOL propulsion, second-generation jet transports and hovercraft. But the real problems facing the newly-merged corporate groups are the same that so often snatched commercial success out of the reach of a sound technical development. The real test of the newly-shaped British aircraft industry will come in how well it concentrates its technical resources on significant targets; how hard it pushes to production and service against its international competitors; and how well it understands the future market requirements.

One other millstone that has hung heavily round the neck of the British manufacturing industry, the Royal Air Force and the airline corporations has been a lack of clearcut, consistent government policy based on an understanding of the vital role of aviation as a critical element of national power in the modern world. Here again organizational changes have been made toward solving this problem by creation of a Ministry of Aviation, but it remains to be seen whether the technically sound and courageous leadership required of this agency will indeed be forthcoming.

Farnborough 1960 is one of those episodes that must inevitably be suffered through with long-standing friends. But it will take more than the organizational changes already effected if the fine technical talent of the British aircraft industry is to get a genuine chance to fight the international competitive battle in this decade to the full extent of its capabilities. We will be watching with considerable interest for evidence of the other basic changes that must complement those already made if any genuine prospect of future success can be hoped for by the British aircraft industry.

—Robert Hotz

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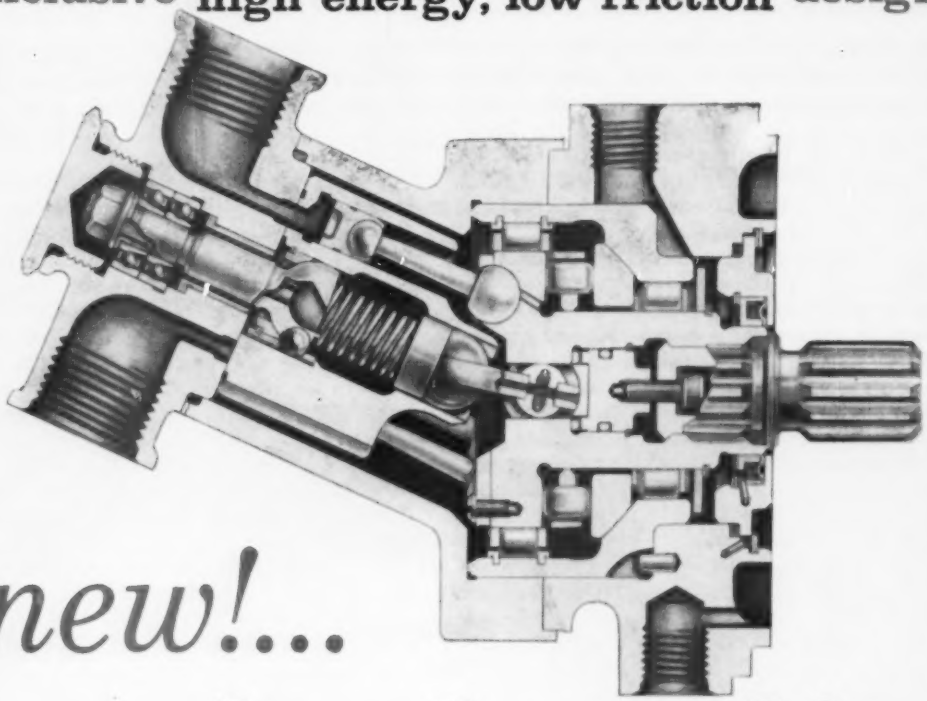

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A. H. Sonnenschein, assistant to the president, Polarad Electronics Corp., Long Island City, N. Y.

Rear Adm. Charles H. Smith (USN, ret.), special assistant to the president, Westinghouse Air Brake Co., Pittsburgh, Pa.

Honors and Elections

Air Research and Development Command has established an Aerospace Primus Club for Air Force research and development personnel making outstanding contributions toward the advancement of this country's aerospace program. Aerospace Pioneer Emeritus awards have been presented to the following ARDC officers and airmen for space achievements: **Col. Alvan N. Moore**, who directs Discoverer recovery operations; **Maj. Robert M. White**, X-15 test pilot who set an altitude record of 136,500 ft.; **Capt. Joseph W. Kittinger, Jr.**, who parachuted from 102,800 ft. from a balloon gondola; **Capt. Harold E. Mitchell**, airplane commander of the C-119 which recovered the Discoverer XIV capsule from the air. Also presented awards were the following members of Capt. Mitchell's crew: **Capt. Richmond A. Apaka; 1st Lt. Robert G. Counts; SSgt. Arthur P. Hurst; TSgt. Louis F. Bannick; SSgt. Alagaene Harmon; A1C George W. Donahou; A2C Lester L. Beale; A2C Daniel R. Hill; SSgt. Wendell King.**

Moulton B. Taylor, president of Aerocar, Inc., will receive an Edward Longstreth Medal from The Franklin Institute for "his conception, design, development and construction of a successful flying automobile . . . fully certified for both ground and flight operation."

(Continued on page 155)

INDUSTRY OBSERVER

► U. S. scientists believe Russia will have satellite intercept capability by 1963. This is ability to track and compute an orbit after two or three passes, then initiate interception and destruction. It implies a vulnerability for multiple-pass satellites that may make single-pass vehicles more attractive for some military uses.

► **Sub-group of USAF Ballistic Missile Division team working on Samos, Midas and Discoverer programs has forwarded its ideas on a co-orbital inspect-destruct vehicle (satellite interceptor) to Defense Department, which is showing increased interest in this type of vehicle (AW Aug. 1, p. 23).**

► Grumman is basing its proposed executive turbojet transport (AW Aug. 22, p. 23) on General Electric's CF-700 turbofan engine. Four CF-700s, developing about 4,000 lb. thrust each, would be buried in swept wings. Aircraft design evolved from Grumman's twin-turboprop Gulfstream.

► **Re-entry heat shield for USAF's Samos reconnaissance satellite program will be designed and produced by Avco's Research and Advance Development Division under a $967,000 subcontract from Lockheed. Goal is to be able to re-enter and recover film packages.**

► Grand Central Rocket Co. is building a reverse flow solid rocket for NASA under Project Wolf (flow spelled backwards). Prototype weighs 500 lb. No specific application is planned, but larger motors will be built if feasibility is proved.

► **Naval Electronics Laboratory plans to order two Dornier Do. 28 STOL twin-engine aircraft (AW May 23, p. 102) for use in Arctic research.**

► Technique of communicating in space by modulating reflected sunlight will be tested by Electro Optical Systems, Inc., for Wright Air Development Division late this year on an eight-mile desert range near Edwards AFB, Calif. To simulate dark sky of space, tests will be made at night using moonlight. Reflected beam will be artificially attenuated to simulate attenuation of extreme distances.

► **Delays in NASA's Scout rocket launching program are related to valving difficulties in second stage hydrogen peroxide control element.**

► Nozzle-less solid rocket is being studied by Grand Central Rocket Co. under a $25,000 NASA feasibility contract. It is theoretically less efficient than conventional motor but could be built for fraction of conventional cost where high performance was not mandatory. Used in a sounding rocket, motor would be a simple tube plus propellant, would be ignited at the top and burn downward, exhausting through a central perforation.

► **Both cruise and ballistic type missiles of 1,500 mi. range are being discussed by Tactical Air Command planners as proposed complement to manned fighter-bombers for the late 1960s. Some observers consider these proposals, which have not yet gone to top USAF echelons for approval, primarily as bargaining material that TAC might trade off for full support of its requested STOL intercontinental attack aircraft (AW Mar. 14, p. 28).**

► Echo II passive communications satellite is scheduled for launch in last quarter of this year or first quarter of 1961. No basic change in payload is now contemplated as a result of successful Echo I tests.

► **Navy is considering proposals for a second-generation doppler navigation system for VTOL aircraft which would provide full all-weather navigation capability. Navy now is furnishing Ryan APN-130 doppler systems to Sikorsky for the HSS-2 and to Kaman for the HU2K as government-furnished equipment, but Laboratory for Electronics is trying to break into the Navy market and has roused interest in its APN-119 system. French also are showing interest in the APN-119 in light of their possible purchase of the HSS-2.**

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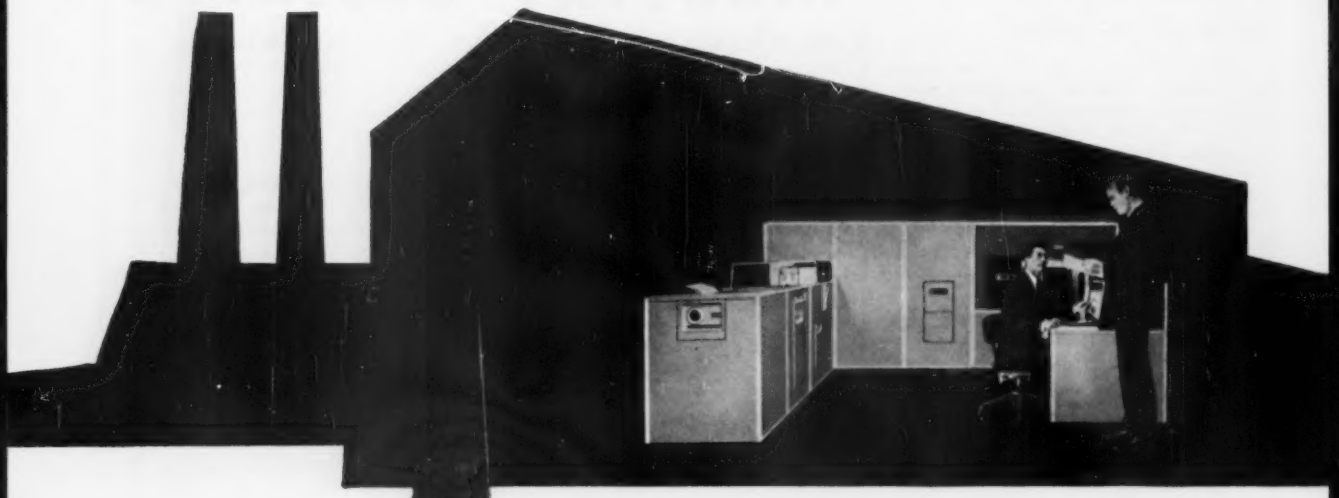

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Washington Roundup

Kennedy's Defense Views

Sen. John Kennedy is beginning to clarify his stand on the defense issue, casting it as more a future than a present problem. He is arguing that Republican defense and fiscal policies have created a trend that will eventually make the U. S. a second-class military power.

This clarification is a counter to Republican campaign claims that the U. S. is the most powerful military force in the world. Vice President Richard Nixon has found it politically popular to stoutly deny any current U. S. military inferiority and to be vague about the future. Now Kennedy is starting to concentrate on future defense problems, soft-pedaling criticism that might appear to be an attack on national prestige.

Kennedy called for a complete overhaul of defense goals last week. He said the next president should give Congress a whole new set of aims, covering overseas commitments, the military base system, weapons and strategy and budget policy.

Republican candidate Nixon proposed a pattern of new scientific institutes last week to strengthen U. S. basic research. In a policy statement on science, one of a series Nixon is publishing on national issues, he said the U. S. must learn the value of basic research, as the Soviets have, if the nation is to maintain its current over-all scientific lead over Russia.

Nixon favors a series of interdisciplinary research institutes, each concentrating on a general scientific area. He uses the need for an integrated approach to meteorological research as an example. Brookhaven National Laboratory, where scientists from several fields explore peaceful uses of nuclear energy, illustrates the approach Nixon recommends.

The Republican candidate believes the next Congress should authorize the National Science Foundation to sponsor this program. The institutes would be established by universities in major geographical areas of the country. They would be administered by an independent board, maintaining only liaison with NSF. Financial support would come from federal and state governments, as well as from industry, foundations and the universities.

Army May Fly Own Close Support

Army may be allowed to operate its own close support attack aircraft as the result of current high level Air Force-Army discussions. Army would get this new role in exchange for supporting USAF's budget request for a new Tactical Air Command fighter with intercontinental ferry range.

Army will probably develop a new short-range VTOL aircraft if it gets the close support job. This new aircraft would be capable of being heavily armed with conventional and small nuclear weapons. The new TAC fighter Air Force wants would carry high yield nuclear weapons and thus would be designed more for strategic war than for close troop support.

Battle over shifting some AMC procurement functions to ARDC is hotter than ever. ARDC wants to take over procurement of weapon systems, arguing that it would be more efficient because the development phase now extends far into a system's operational life and because there are relatively few systems bought in large numbers now (AW May 23, p. 25). AMC fights the proposal because it fears being reduced to a nuts and bolts type procurement role.

The fight probably will go to Air Force Chief of Staff Gen. Thomas White for settlement. ARDC Commander Lt. Gen. Bernard A. Schriever and AMC Commander Gen. Samuel E. Anderson have been unable to reach agreement.

Respite for Mercury

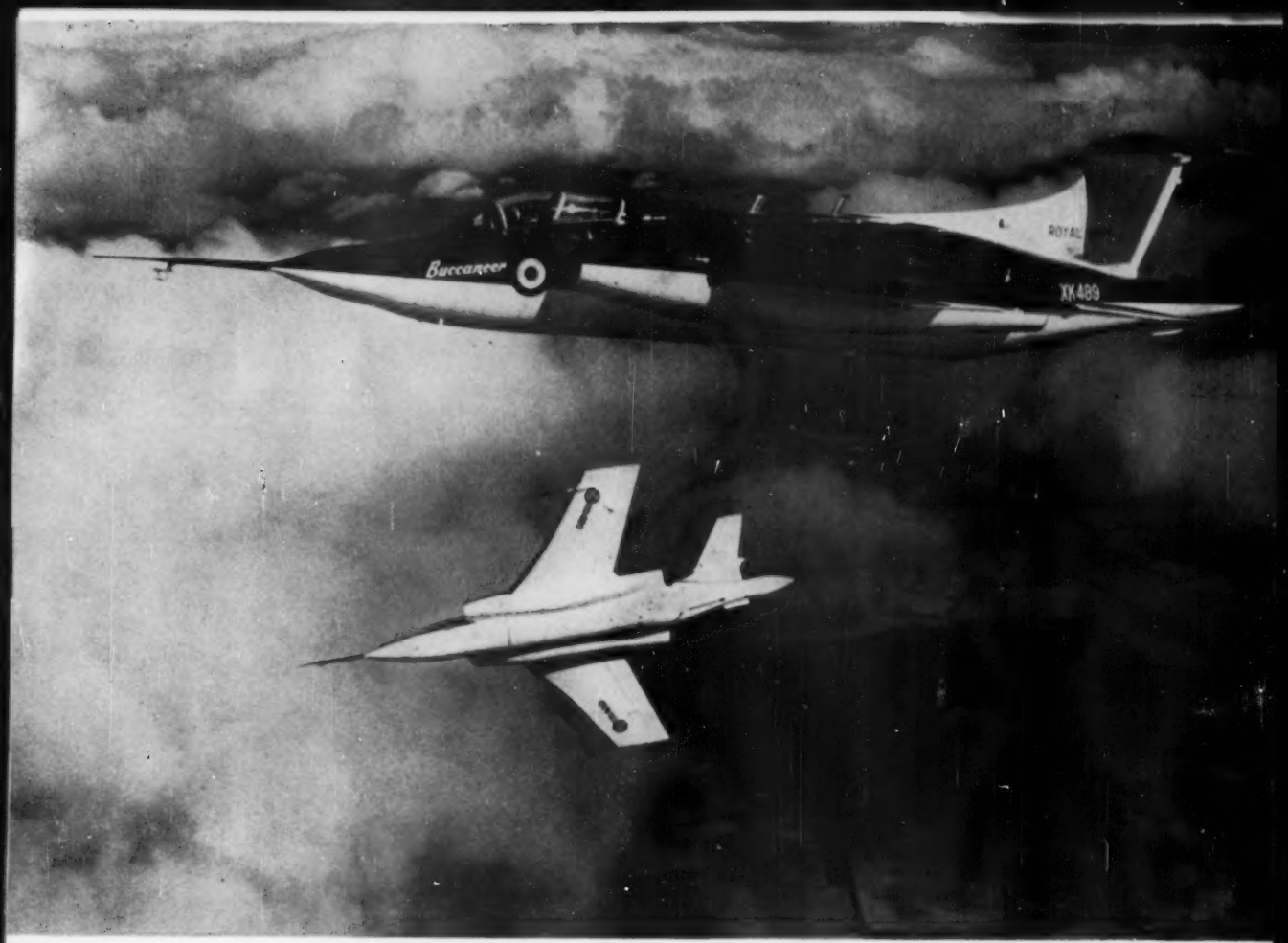
Project Mercury team has a temporary respite from congressional pressure. House Science and Astronautics Committee has postponed its staff investigation of U. S. space programs until after Jan. 1. This gives National Aeronautics and Space Administration a chance to meet its present target of launching a manned Redstone flight in December or January, thus offering some solid progress before hearings start.

Mercury progress in the next few months could allay some congressional criticism, but expected Soviet attempts will keep the heat on. Soviet Premier Nikita Khrushchev reportedly has said Russia will soon launch a 60-ton satellite—"a whole train." He made the remark to an electrical plant worker during his recent tour of Finland.

Costs continue to mount as Project Mercury moves along. The Mercury global tracking network, once estimated at $35 million, now is expected to run $50-53 million.

Soviet space success bringing two dogs back from orbit caught Republican campaign propaganda short last month. A "GOP Victory Wheel" providing workers with capsule positions on major issues proclaimed that the U. S. "leaps ahead of Russia in space." Noting U. S. satellite successes, the wheel informs voters the USSR has only one earth satellite and one orbiting the sun, "both silent."

—Washington Staff



PAIR OF BLACKBURN NA. 39 carrier-based Navy strike planes shown in pre-production configuration. Powered by two de Havilland Gyron Jr. engines and armed with nuclear weapons, NA. 39 is specially designed for high subsonic penerations at low level.

Farnborough's Missing New Aircraft Sign

VICKERS VIGILANT anti-tank missile is shown in container designed for use by paratroops. Vigilant in new version will be used by British Army. Armored car mounting is shown (right).

AVRO 748 twin-Dart-powered transport was the only new aircraft exhibited at the show. A. V. Roe is billing the transport, selling for $650,000-$750,000 depending on model, as a DC-3 replacement. U. S. sales campaign was conducted earlier this year.

Of Transition

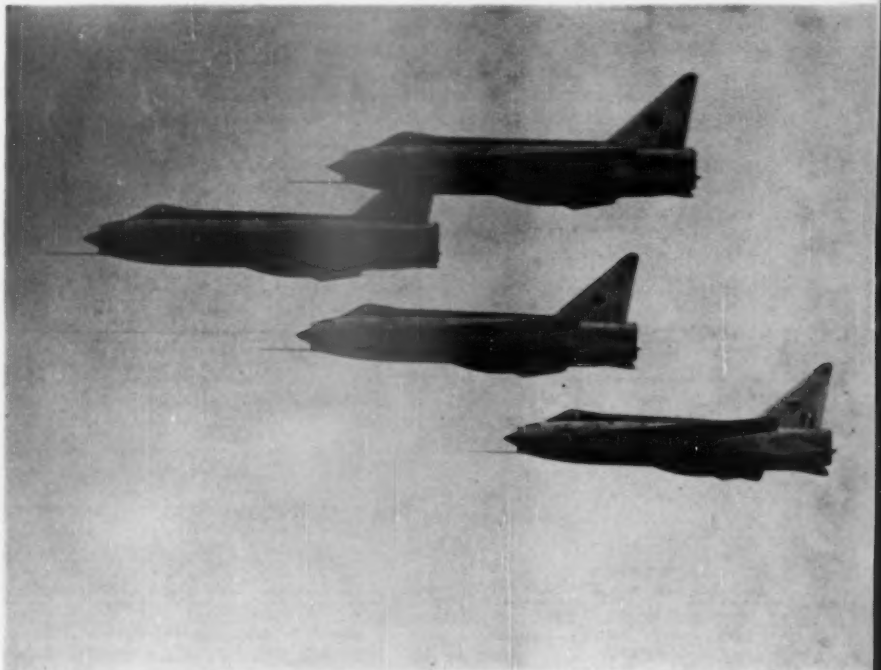
Farnborough—British aircraft industry appeared to be in a trough of technical transition this week at the 21st Flying Display of the Society of British Aircraft Constructors at Farnborough.

The flying show was the thinnest in the postwar history of the event and the principal technical interest was found in the huge exhibition tent among the engine exhibits, models of future designs and project brochures.

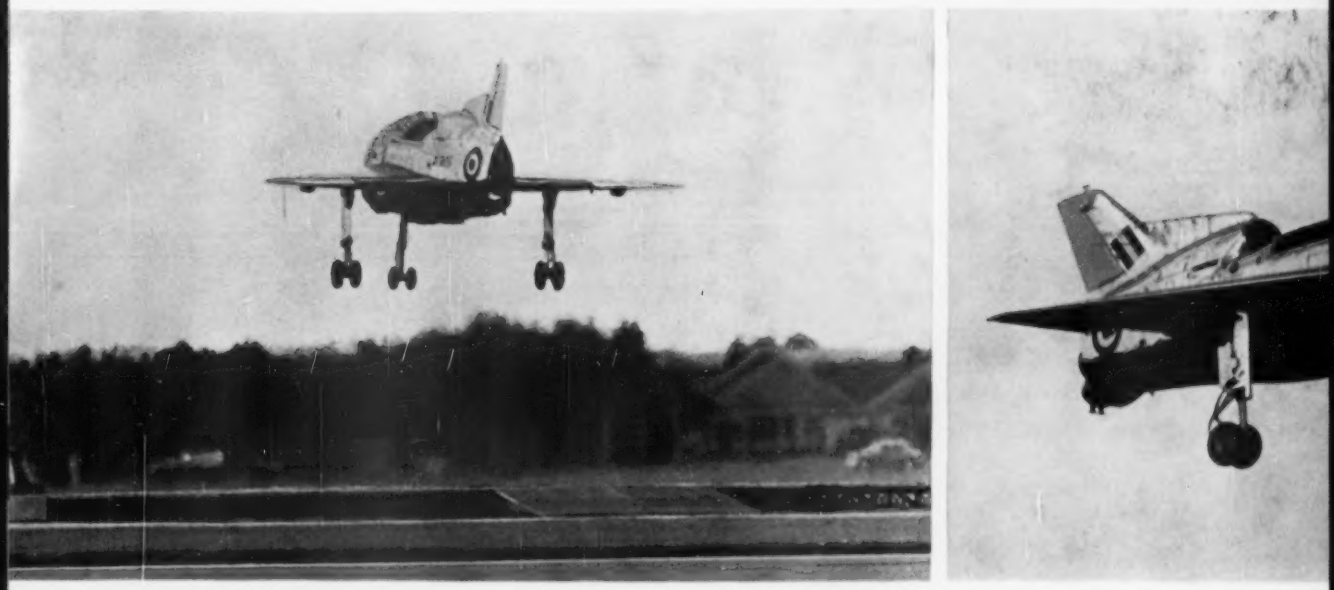
Only one truly new aircraft—the Avro 748 turboprop transport—was on exhibit in the flying display and such venerable designs as the Hawker Hunter, de Havilland twin-boom Sea Vixen and Dove and the Folland Gnat were required to fill up an afternoon of flying.

The Short SC.1 VTOL experimental prototype which appeared for the first time at Farnborough last year made its first public transition from vertical rising to forward flight as the technical high spot of this year's flying display.

Powered by four Rolls-Royce RB.108 engines of 2,000 lb. thrust after full air bleed for aircraft control system and a single RB.108 for cruising flight, the



FORMATION of four English Electric P.1B Lightnings is flown by pilots of No. 74 Squadron, Royal Air Force, the first operational squadron to be equipped with this supersonic fighter.



SHORT SC.1 VTOL/RESEARCH aircraft shown during its first public transition is powered by four Rolls RB.108 jets for lift and a fifth solely

SC.1 took off from a steel platform in an absolutely vertical rise to about 30 ft., hovered and maneuvered around 360 deg. and then darted forward in level flight. The steel platform was necessary because last year the SC.1 took off from freshly mowed grass and the engines ingested sufficient hay to force a suspension of operations.

The SC.1 uses its battery of lift engines for about 18 sec. on vertical takeoff and then deflects them about 20 deg. to establish initial forward speed. On descending in a vertical landing, the lift battery of engines functions for about 25 sec. Rolls is designing its special lift engine series on the assumption of at least a full minute's use in both maneuvers.

The SC.1 research vehicle and the Rolls engines powering it represent one of the two basic British approaches to the VTOL problem. This approach believes that special lift engines must be designed solely to provide maximum efficiency for that function with another propulsive system to provide cruising power. The Rolls philosophy of lift engines maintains that sufficiently high power-weight ratios can be achieved to provide an over-all gain in aircraft efficiency for total mission. The RB.108 now provides 8 lb. thrust for each pound of engine weight but Rolls already has a development engine running at 10 to 1 and sees no problem in doubling this to 20 to 1 for useful VTOL operational vehicles.

The other British approach, supported by NATO mutual weapons development funding, is exemplified by the Bristol Siddeley BS 53 engine and the Hawker P.1127 VTOL fighter project (AW Aug 22, p. 36). The Hawker aircraft prototype was originally scheduled for the Farnborough show but its initial flight date has been slipping. It now is expected to get into the air sometime this fall. The Bristol Siddeley approach involves using the same engine to provide both lift and thrust by swiveling the tailpipes and diverting the thrust to the desired direction.

NATO Choice

Currently it has been designated as the engine around which NATO VTOL projects should be designed, much in the same manner the Bristol Orpheus was specified for all NATO lightweight fighter designs. However, technical observers predict that this competition between these two different approaches to solving the VTOL propulsion problem will develop into one of the major technical battles of the next decade.

Although Short Bros. & Harland and other British manufacturers have proposed development of the SC.1 principles into operational VTOL military vehicles grossing up to 100,000 lb. and operating at level speeds up to Mach 2, the official British support so far has been thrown behind the competing system with the Germans, operating under a Rolls license, picking up this line of fighter development.

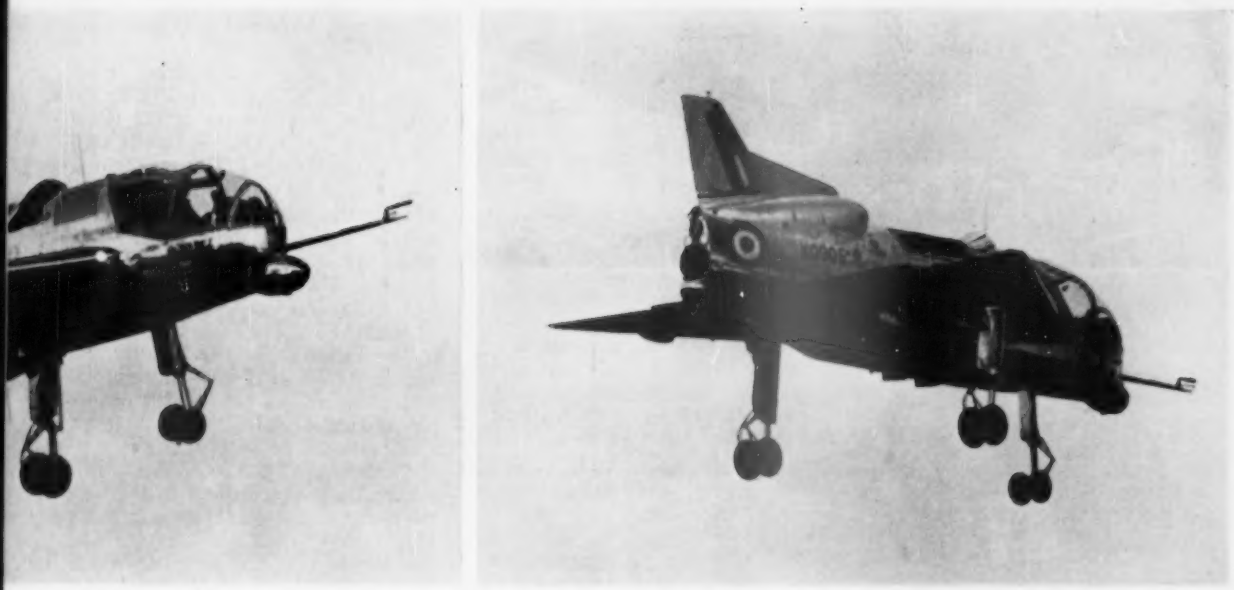
British engine development continues at a lively pace along a wide range of the propulsion spectrum with the large rocket field appearing to be its only major deficiency. The engine developments of the Bristol Siddeley combine and Rolls-Royce—representing actual development work in progress with test-stand-running engines rather than the brochures that were characteristic of the aircraft projects—were a technical highlight of the current Farnborough show.

The increasingly complex pattern of international licensing agreements spearheaded by the engine manufacturers and the increasing difficulty of providing enough purely British prototypes to make the flying display worthwhile is putting heavy pressure on SBAC to modify its show rules to allow some types of foreign equipment to appear. British engine makers have long chafed under the restrictions that prevent them from displaying foreign airframes using their powerplants and it appears likely that this is one of the SBAC rules that will be abandoned before next year's show.

An example of the absurdity of this rule was pointed out by British engine manufacturers in the Lancashire Aircraft's Prospector agricultural plane. This plane is marketed with U.S. Lycoming engines and because of this is barred from participating in the flying display. So the production versions with Lycoming engines were on static exhibit while the flying article was specially equipped with an ancient British Cheetah engine. Foreign influence already has crept into the static display with the

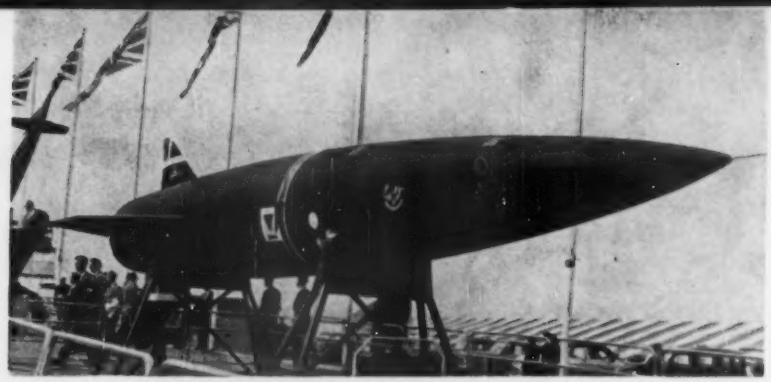
Farnborough Coverage

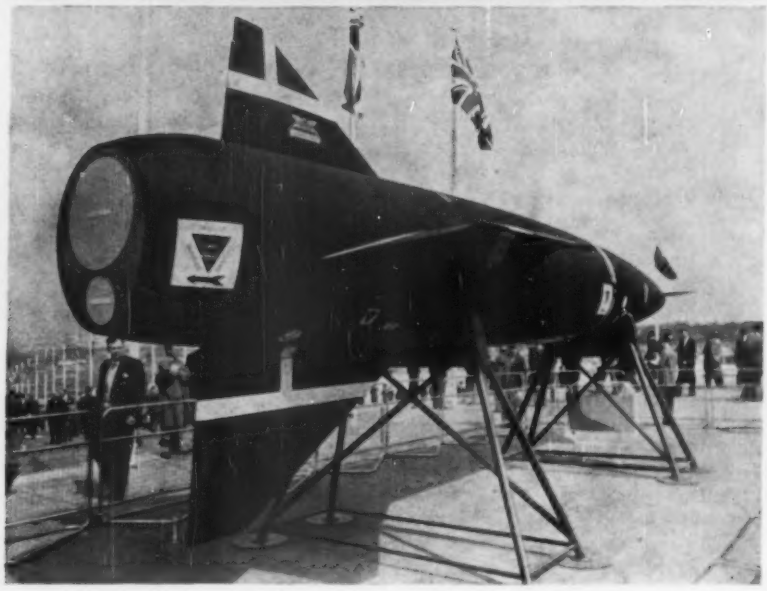
AVIATION WEEK covered the 21st Flying Display of the Society of British Aircraft Constructors last week at Farnborough with an editorial team headed by Editor Robert B. Hotz and including Cecil Brownlow, European editor, and L. L. Doty, transport editor.



for use in forward flight. SC.1 made transition from vertical to forward flight in 18 sec. on takeoff and 25 sec. on landing.

ONE EACH of England's helicopters, all now manufactured by Westland, join the now-traditional echelon at Farnborough. From left: twin-Gazelle-powered Belvedere; twin-Eland-powered Westminster; Gazelle-powered Wessex; Gnome-powered Whirlwind; two Nimbus-powered Sprites; Turmo-powered Skeeter. Whirlwind and Wessex are license-built Sikorsky airframes re-engined with British gas turbines. Belvedere is former Bristol Type 192; Sprite and Skeeter are former Saunders-Roe developments.





AVRO BLUE STEEL air-to-ground missile is capable of carrying a hydrogen warhead over 500 mi. range from launching aircraft. Bottom photo shows orifices for two-barrel Bristol Siddeley Stentor rocket engine. Upper chamber provides constant thrust while the lower chamber has variable thrust. Stentor is fueled by peroxide and kerosene. Missile uses inertial guidance system. Blue Steel has canard surfaces on stainless steel missile fuselage with aft fins used for in-flight control. Horizontal fins have washed down tips and blunt trailing edges for efficiency at supersonic speeds.

BATTERY OF THREE PYE PV wire-controlled missiles is mounted on a mobile launcher. This 80-lb. missile is designed for infantry use against armored targets.

small turbine engines licensed from the French and the Nord CT.41 ramjet airframes flying British engines.

The only other notable flying, in addition to the SC.1, was provided by the valedictory performances of the Royal Air Force Treble One Squadron with its Hawker Hunters. The squadron is scheduled to be re-equipped with English Electric supersonic Lightnings and will be forced to abandon aerobatics while this operational transition is in progress. The Lightning now is in its first operational use with 74 Squadron of the RAF.

The British helicopter industry also appears to be in a state of technical transition with no new models on display and not much indication that much really new will be forthcoming soon.

With Britain's first-generation missile systems now entering or approaching the operational stage, the show included Farnborough's most comprehensive missile display thus far, including Avro's Blue Steel strategic air-to-ground weapon system.

Support Missile

It also spurred the announcement of a new solid-propellant army corps support missile, the Blue Water, under development by English Electric Aviation.

Still in the research and development stage, Blue Water is 25 ft. long with at least four stubbed control surfaces around its midsection and a tail fin for stability. Over-all wing span is 6 ft. 9 in. Fin span is 6 ft. 5 in. Maximum diameter of the tactical surface-to-surface missile is 2 ft.

Equipped with an inertial guidance system to minimize effectiveness of electronic countermeasure efforts, the medium-range ballistic missile is being designed for rapid deployment in the field and with capability of operating with minimum number of support vehicles and personnel.

Several firings of Blue Water test vehicles already have been conducted.

West Germany also is interested in Blue Water, and German defense officials were in England last week to discuss weapon system developments with their British counterparts. British Defense Minister Harold Watkinson stressed, however, that any agreement to supply West Germans with weapon systems of any type would be handled within the framework of the North Atlantic Treaty Organization, rather than on a bilateral basis.

Bomber Weapon

Mark 1 Blue Steel on display at Farnborough represented the first production series of the air-to-surface weapon system designed to be carried by Britain's V-bomber force. Present range is estimated at over 200 mi. and develop-

ments to significantly increase its capability are under way.

Supersonic Blue Steel which carries a nuclear warhead is powered by a two-chambered Bristol Siddeley Stentor rocket engine using high-test peroxide and kerosene. Smaller of the Stentor's two chambers, located directly beneath the larger unit, apparently can be vectored during flight to permit the missile to change course or altitude.

Bomb-shaped with canard geometry, Blue Steel—like the Blue Water—is equipped with an inertial guidance system. It has an over-all length of approximately 35 ft.

Other missiles on display, all of which had seen previous Farnborough service, included:

• **Battery of four** English Electric solid-propellant Thunderbird mobile anti-aircraft missiles, in use by British army, and their support equipment.

• **Bristol/Ferranti Bloodhound** fixed-site anti-aircraft missiles powered by two Bristol Siddeley Thor ramjets and operational with Royal Air Force units.

• **Vickers Vigilant.** Pye and Malkara anti-tank weapon systems. Latter missile was developed by Australia's government aircraft factories, with Fairey Engineering, Ltd., acting as its European agent.

• **Seaslug surface-to-air** missile scheduled to become Royal Navy's standard medium-range anti-aircraft weapon and due to go aboard its first guided missile destroyer, HMS Devonshire, next year. Principal Seaslug contractors are Armstrong Whitworth Aircraft, Ltd., Sperry Gyroscope Co., Ltd., and the General Electric Co., Ltd.

• **Short Seacat** short-range anti-aircraft missile system under development for Royal Navy.

• **Infrared de Havilland** Firestreak air-to-air missile.

Target Drones

Two target drones, both developed outside the British Isles, also were on display—Australia's subsonic Jindivik, powered by a Bristol Siddeley Viper turbojet, and France's supersonic Nord CT.41 being built under license by Armstrong Whitworth. Powered by two ramjets and launched by two single-stage solid propellant rockets, CT.41 has a maximum speed of Mach 2.5. It is radio controlled and recoverable.

As a highlight of the flying display, four aircraft from each of Britain's three V-bomber types were scrambled from a strip alert on successive days.

With aircrews already aboard but with engines cold, all four Vickers Valiants of RAF Bomber Command 148 Squadron had cleared the runway 1 min. 58 sec. after the scramble order was given, with the first plane beginning its takeoff roll within 30 sec.

The following day, four Avro Vulcans

USAF Strengthens Samos Effort

Washington—Samos reconnaissance satellite is being given strong new emphasis under an Air Force reorganization move that indicates the Administration is trying urgently to plug the aerial reconnaissance gap before diplomatic complications or development of an anti-satellite capability bars this approach.

Development of Samos is being moved directly under the Secretary of the Air Force—an unprecedented step in USAF development history.

This indicates that recent reappraisals of the Samos program at the White House, State Department and Defense Department levels—brought about by Russia's intensive propaganda attacks on U. S. reconnaissance techniques—have been decided in favor of speeding Samos development in spite of its diplomatic implications.

Since the Lockheed U-2 reconnaissance aircraft was downed May 1, Russian propaganda organs have been increasingly critical of what they call "provocative" U. S. violations of Soviet airspace, domination of the space program and other U. S. policies by the Pentagon, use of satellites for spying purposes and creation of an atmosphere that prohibits international cooperation in space research (AW Aug. 22, p. 33).

Although Russia has never formally protested flights of satellites over Russian territory, there is considerable speculation that the current propaganda effort may be a buildup to such a protest by Premier Nikita Khrushchev when he comes before the United Nations next week.

Brig. Gen. Richard B. Curtin, until a few months ago head of space systems at Air Research and Development Command's Ballistic Missile Division, will head Samos development in the new office, either with the title of director for satellite systems or special assistant to the secretary for satellite systems.

In a parallel move at the BMD level, Brig. Gen. R. E. Greer has been named vice commander for space security reconnaissance. Gen. Curtin recently had been deputy director of systems development and assistant director for advanced technology under USAF's deputy chief of staff for development, and Greer had been assistant chief of staff for guided missiles.

Congress recently approved extra funds for Samos development, and Defense Secretary Thomas S. Gates, Jr., has said he probably will use at least $50 million of this in addition to the $200 million asked for this fiscal year by the Administration (AW Aug. 15, p. 26).

Along with organizational and fiscal changes, there are indications that technical improvements for Samos are being planned.

Return of electronic and photographic intelligence picked up by Samos is expected to be accomplished both by electronic readout and physical recovery. Until recently, physical recovery has been based solely on return of a capsule by the complex retrorocket method typified by the Discoverer capsules.

Now, apparently, an expanding skirt drag-brake capsule system of the type proposed by Avco (AW June 22, 1959, p. 81) for the Air Force man-in-space program and later for the National Aeronautics and Space Administration Mercury program, which superseded USAF's work, will be developed as a backup method for recovering Samos capsules.

USAF has shown increasing interest in the drag-brake approach (AW Aug. 22, p. 23) and is about to award Avco $6 million to develop it. If this technique can be proved successful as expected, it will be incorporated into the Samos program under present plans.

There also is an outside possibility that the Samos capsule might be used for a second manned space flight program if existing sentiment in Congress and in some parts of USAF should ever result in a national decision to back up NASA's Mercury project.

Proponents of a Mercury backup see a need for a second program—possibly for a two-man satellite within roughly the same time period as Mercury—as not only valuable insurance but also as a way to lessen the psychological impact if Russian astronauts beat the U. S. into space as is now expected.

Cost of a second program probably would be prohibitive. Until and unless such a program were ordered by the White House and funded adequately by Congress, USAF would undoubtedly continue to put its greatest emphasis on the projected Dyna-Soar boost glider, which it expects to be orbital and maneuverable and therefore far more useful than a simple orbiter such as Mercury or a modified Samos.

Samos will be able to carry cameras with focal lengths as large as 40 in. In at least one configuration, it could be equipped with as many as a dozen cameras, probably having a variety of focal lengths and types of film.

WESTLAND WESTMINSTER twin-turbine helicopter prototype powered by two Napier Eland engines is being used for development of transport, flying crane and military helicopters. Avro Vulcan B.2 is shown below in takeoff using four advanced versions of Bristol Olympus turbojets rated at 17,000 lb. thrust. Vulcan will carry both British Blue Steel and Douglas Skybolt air-to-ground missiles. Later versions of the Vulcan will use 20,000-lb.-thrust Olympus and carry two Skybolt missiles.

from 617 Squadron were scrambled in total elapsed time of 1 min. 47 sec. Final V-bomber scramble was scheduled to be made by four Handley Page Victors from No. 15 Squadron.

Under present practice, such an RAF crew alert, with bombers at dispersal sites, would go into effect after British Defense Ministry received intelligence warning of an impending attack. Scramble order would be received by crews in the cockpit.

Talon Restrictions Partially Lifted

Progress in the final phases of the flight test program of the Northrop T-38 Talon supersonic trainer has resulted in lifting several of the restrictions placed on the aircraft as interim measures:

- **Interim acceleration limit** soon will be removed and raised to the 7.33g design limit. The aircraft still is undergoing investigations of the velocity vs. gravity (v-g) diagram but has attained maximum g test points "many times," officials said.
- **Maximum permissible airspeed** has been raised to 700 kt. IAS.
- **Landing gear down-limit** speed has been raised from 220 kt. to 300 kt.

Northrop reports that the lateral instability at liftoff noted in AVIATION WEEK pilot evaluation (AW Aug. 29, p. 96) is not present in all aircraft. The No. 10 aircraft flown experienced uneven but correctible gear retraction.

British Hunt U.S. Market for Transports

Farnborough—British aircraft industry, undaunted by dwindling markets and stiffer competition, is making a bid to invade U.S. markets with a line of transport aircraft that shows no major performance advance over types already in service.

Only one new transport aircraft, the Avro 748, made an appearance last week at the 21st Flying Display and Exhibition sponsored by the Society of British Aircraft Constructors at Farnborough. All other types shown have been available for several years. Most promising hopes for the future of British transport sales appear to rest in engine development and in a high-speed, extremely long-range transport, the Vickers-Armstrongs Super VC.10, now on the drawing boards with a target delivery date of 1965.

New orders for transport aircraft announced during the show totaled 27 but none of the sales are outside England. They are:

- **Five additional de Havilland** Comet 4Cs ordered by the Royal Air Force.
- **Six Handley Page Heralds** ordered by Jersey Airways, an independent British operator.
- **Sixteen Armstrong Whitworth Argosy** 660 air freighters ordered by RAF.

Aircraft Orders

Large majority of previous orders for aircraft shown at the display are also confined to British or Commonwealth interests. Order for three Avro 748s has been received from Skyways and order for two from BKS Air Transport, Ltd., both British independent operators. Aden Airways, a British Overseas Airways Corp. subsidiary, has ordered three of the Series Two model which will be powered with two Rolls-Royce R.Da. 7 Dart turboprop engines rather than two R.Da. 6 engines which power the Series One model ordered by the two British airlines.

A. V. Roe, manufacturer of the 748, conducted a sales campaign in the U.S. earlier this year and claims to have evoked some interest from local service carriers, particularly Frontier and Central. The company plans to make further sales contacts among U.S. trunklines and executive operators. Billed as a Douglas DC-3 replacement, Series One of the model will sell for $650,000, Series Two for $750,000 with a delivery date of mid-1961. A 40-44 passenger transport, the 748 will cruise at 230 kt. at 20,000 ft. and will carry a maximum payload of 9,666 lb. over a range of 580 nautical mi.

A competitive running mate, the Handley Page Herald, is a 47-passenger high-wing transport also powered with twin Dart turboprop engines. Although the plane has been demonstrated in 53 countries, no sales campaign has been conducted in the U.S. and none is being planned until the Herald undergoes actual experience in scheduled service.

Ministry of Aviation has purchased three Heralds for British European Airways and a provisional agreement for seven of the airplanes has been signed by VASP of Brazil. A stretched version of the Herald, through a 42-inch extension of the forward fuselage to increase capacity to 50-56 passengers, has been developed by the manufacturer. The Herald was first flown in 1958 and is now in production.

Argosy Orders

Orders for two Argosy AW.650 air freighters have been placed by Trans-Arabia Airways and five by Riddle Airlines. Financing on the latter order has not been completed and it is understood here that prospects of British money supporting at least a portion of the Riddle transaction are slim because of the recent difficulties Vickers-Armstrongs has had with its Capital Airlines loan. Company officials say an order for eight more Argosys by a U.S. company is imminent.

Certification of the Argosy, which first flew in January, 1959, is expected late this fall. Royal Air Force originally ordered 40 AW.660s, military version of the Argosy, and increased the order to 56 last week. Proposed developments of the Argosy include the AW.670, a six-car and 30-passenger model, and the AW.671, a 126-passenger airbus. The company also plans to supplement the Argosy's four Rolls-Royce Dart turboprop engines with Rolls-Royce lift engines mounted on the outer wings to give it STOL capabilities. Armstrong Whitworth plans a U.S. sales campaign this fall with the first Riddle aircraft to be delivered in October as a demonstrator to airlines.

De Havilland still is confident that sales of its Comet turbojet transport will increase and is now estimating that at least 50 more will be sold off the production line. Number of Comets sold to date totals 56. Vickers-Armstrongs is not so optimistic about its Vanguard turboprop transport and, according to one company official, feels that no more than 10 Vanguards in addition to the 43 on order will be sold.

Total of 20 have been sold to BEA, and 23 to Trans-Canada Airlines. Original delivery date of last spring has been set back to December because of turbine disk difficulties experienced in the Rolls-Royce Tyne engines which power the Vanguard. Manufacturer had hoped to have the airplane in service with British European Airways this summer during peak traffic periods to demonstrate its low seat-mile costs to permit low-fare services. BEA had planned to schedule the Vanguard for regular service in June and now has a target date of March, 1961.

More Planes

There are more medium-range planes to come. On the boards is the BAC-107, a 50-59 passenger transport powered by two aft-mounted Bristol Siddeley BS-75 ducted fan engines. An original Hunting design conceived some three years ago, it will be manufactured by Vickers-Armstrongs and will be available in 1965 as a Viscount replacement. No orders for the model has been placed as yet (AW Aug. 1, p. 40). A. V. Roe is studying a similar design, the Avro 771 (AW Sept. 5, p. 43).

The DH-121 Trident manufactured by De Havilland is aimed for the short-haul market and will cruise at about 585 mph. Powered by three aft-mounted Rolls-Royce RB163 bypass engines, each giving 10,400 lb. static thrust at sea level, the Trident will fly a 900-mi. stage length with 100 passengers at a cost of one cent per seat-mile. BEA has ordered 24 of these planes.

Vickers-Armstrongs' VC.10 long-range transport is Britain's largest current civil aviation project. BOAC has ordered 35 VC.10s which will be powered by four aft-mounted Rolls-Royce Conway engines. The Super VC.10 with fuselage extended 28 ft., will carry up to 212 passengers and will have a gross weight of 347,000 lb. A third version, called the "Super-Super VC.10" with a further 10 ft. added to the fuselage, is now in the design stage and is aimed for U.S. markets.

In the engine field, Rolls-Royce is now expecting to boost authorized time between overhauls on its Avon turbojet engine from 2,000 hr. to 2,300 hr. The Conway is now at 1,000 hr. and the Dart engine operated by Trans-Canada is at 3,000 hr. TBO.

Rolls-Royce is projecting thrust of its Conway bypass engine from a current 17,500 lb to 18,500 lb. in 1961 and 20,050 lb. in 1963. Eight RB.141 bypass engines are now being run through development tests and will have an initial rating of 15,000 lb. with delivery set for 1961. These engines will power the Sud Aviation Caravelle VIII.

The RB.163 which will power the DH-121 Trident is undergoing test runs which will be completed in November. Production delivery of the engine, which will have an initial rating of 9,850 lb. thrust, is set for late 1962.

New Tail Designed for Kaman H-43B Huskie

First production Kaman H-43B Huskie with new tail configuration has been delivered to U. S. Air Force at Warren AFB, Wyo. New vertical tail surfaces are 14 in. lower than on previous models. Kaman said advantages are reduced vibration and better flight characteristics through a reduction in control input requirements for forward flight. Retrofit units will be delivered to bases for installation in the field.

Echo Is Continuing To Reflect Signals

Washington—Echo satellite was showing the effects last week of micrometeorite punctures and temperature variations from flying in the earth's shadow, but National Aeronautics and Space Administration said the sphere remained an excellent signal reflector.

Echo has lasted well beyond its anticipated 10-day useful life, but minor variations in signal strength have developed in the messages bounced off its surface.

Signal strength variations plus fluctuations in the brilliance of reflected light indicate a loss of surface tautness and spherical shape.

NASA now estimates that Echo will stay in orbit about a year, but the agency cannot forecast how long the satellite will remain a useful reflecting sphere.

NASA said about 400 voice and continuous wave transmissions have been sent using Echo as relay. Of these, about 24 have been transatlantic experiments.

The sphere entered the earth's shadow for brief portions of each orbit beginning Aug. 24 (AW Aug. 29, p. 31), 12 days after it was launched. Original estimate of a maximum of 30 min. flight in darkness of each orbit has been increased to 35-40 min.

Variations in brilliance are attributed to wrinkling from loss of sublimating gas through micrometeorite puncture and 242 venting holes. The 31,000 sq. ft. Mylar sphere is subjected to temperature variations ranging from minus 80F in the earth's shadow to plus 240F in sunlight, which could cause sublimating gas to return to powder.

Orbital elements of the sphere have been relatively stable since launch. The period has increased .03 sec. to 118.33 min.; apogee is down 2.8 mi. to 1,047.7 mi., and perigee is increased 3.3 mi. to 948 mi.

Initial reports that Echo was twinkling came a few days after launch from volunteer observers, but NASA attributed this phenomenon to atmospheric conditions rather than to irregularities in the shape of the sphere.

One-year orbital life forecast last week was the first time NASA had placed an official estimate on the time Echo will circle the earth.

The agency said previously that the thin solar cells used to power tracking transmitters probably will not last more than a year.

Echo has been tracked in, through and out of the earth's shadow, with signals fading during dark periods.

Biological Warfare Warning

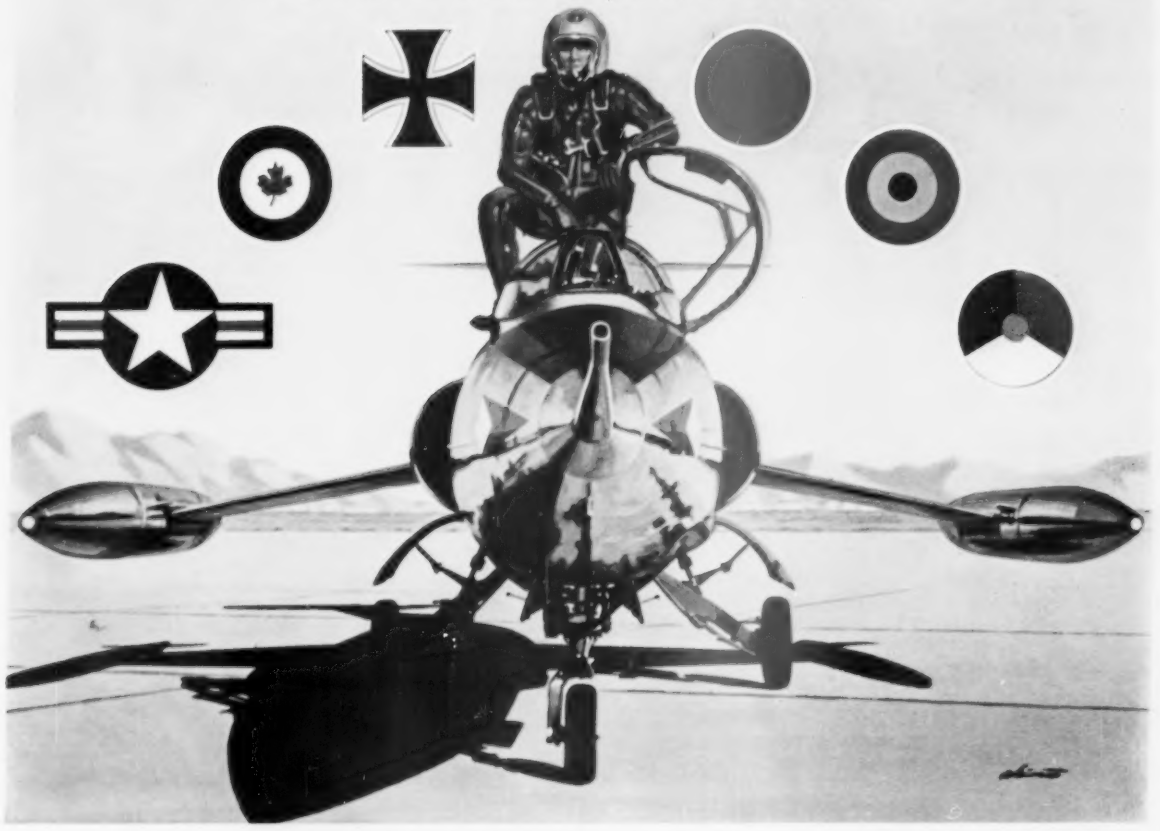
Washington—Five prototype models of a biological warfare rapid warning system (BWRWS) will be developed by Douglas Aircraft Co., Santa Monica, Calif., under contract from Army Chemical Corps. Projected to be housed in trailer vans located in various parts of the country, the system will be designed to establish standard patterns—norms—for partical contamination in the atmosphere, in relation to seasonal periods, weather, and day and night conditions.

Since spread of biological contamination will vary with meteorological changes, the theory is that there will be sufficient time to take adequate precautionary measures.

Included in the prototype system will be two Army-developed alarm devices:
- **Ratio alarm, which functions to detect an unusual concentration of atmospheric particles, also gages their size.**
- **Particron analyzer, which will distinguish between biological and dust particles.**

The Chemical Corps intends to proceed with the development of a biological rapid warning system to cover the continental U. S. This deployment will be known as CONUS.

THE LOCKHEED F-104 STARFIGHTER



The free world's finest operational weapon, in any language

. . . the Lockheed F-104 is now flying or will soon be in production for the United States, Canada, West Germany, Japan, Belgium and The Netherlands. World speed and altitude record holder, this defensive fighter-interceptor is also being considered for purchase by other free world nations.

The Garrett Corporation is proud of its long association with the Lockheed Aircraft Corporation which has produced the F-104 and many other outstanding military and commercial aircraft.

The F-104 systems supplied by Garrett's AiResearch Divisions are designed to meet the particular type of mission required by an individual country's defense program. AiResearch system responsibility includes central air data, air conditioning and pressurization, engine starting and ground support, and actuation, control and emergency power.

The world-wide facilities of Garrett stand ready to contribute to the success of the F-104 program in the countries of the free world.

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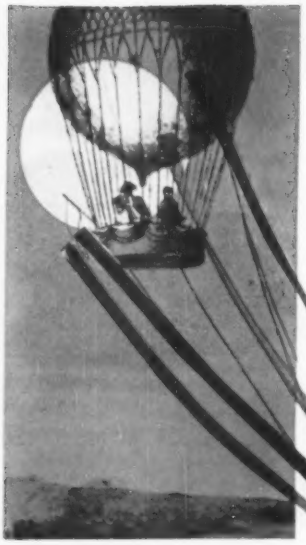

One of a series depicting historic incidents in military communications

National guard forces under Gen. Jourdan decisively defeated the Austrian Army of the Prince of Saxe-Coburg at Fleurus, June 26, 1794, saving Paris and the French Revolution. A decisive factor was the use of balloons and a system of signals to communicate with the ground. Airborne data link permitted the French to swiftly counter enemy moves.

AIRBORNE INPUT — 1794

Primitive balloons were a step toward filling the need for airborne intelligence. Today, in an age requiring split second interchange of military data, the need is met by instantaneous and completely reliable airborne Electronic Communications. ECI is proud to design, develop and manufacture advanced equipment for our defense in aerospace and surface roles. An example: ECI's communications and data link equipments which form an integral and most essential part in the new and vital ALRI (Airborne Long Range Input) program linking USAF's advanced early warning system to SAGE — our continental defense network.

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U.S. Defectors Aid Soviet 'Spy' Charges

Washington—Soviet Russia last week used the defection of two employes of the U.S. National Security Agency to continue its propaganda campaign against U.S. aerial reconnaissance and communications intelligence policies in preparation for Soviet Premier Nikita Khrushchev's visit to the U.S. next week (see p. 31).

Bernon F. Mitchell and William H. Martin, missing for several weeks from their jobs as junior mathematicians at the communications intelligence agency near here, appeared at a Moscow press conference to announce that they were becoming Russian citizens.

Staging of the press conference was reminiscent in its propaganda aspects of the trial of U-2 pilot Francis G. Powers as Martin and Mitchell made statements and answered questions concerning massive monitoring of radio circuits by NSA and photographic penetration flights of Russia and China.

Official U.S. reaction to their defection brought demands for congressional investigation and administrative review of screening procedures for prospective employes of sensitive agencies.

Martin and Mitchell, who had worked for NSA since 1957, disappeared during a vacation period in June and July. On Aug. 1, Defense Department said it was searching for the two. On Aug. 5, Defense said that it must be assumed that they had gone behind the Iron Curtain.

Defection Planned

The defection was planned more than a year ago, the two said. A statement listing their reasons for leaving was deposited by Mitchell in a Maryland bank, where it was found by investigators early in August. The statement came to public notice for the first time when a copy of it was read at the Moscow press conference.

It said the decision to defect was not caused by the U-2 incident, which was "merely an instance where the truth was too obvious to be permanently suppressed or altered."

In a second statement read in Moscow, they said NSA gathers communications intelligence from more than 40 nations of the world for use by the United States government at a cost of $500 million per year and that they were dissatisfied with the methods of gathering this intelligence, including "the U.S. policy of deliberately violating the airspace of other nations."

The two men, both bachelors, served in the U.S. Navy from 1951 to 1954. Their last two years were spent at the Naval Communications Facility at Kamiseya, Japan, 40 mi. southwest of Tokyo, as communications technicians. Whenever a reconnaissance flight was planned along the Chinese or Soviet far eastern coasts, a top-secret message would be sent to Kamiseya and other communications intelligence stations informing them of the flight time and course of the plane, Martin and Mitchell said.

NSA Analysis

Monitors at these stations then tuned in radar reporting stations of the target country and pinpointed their locations by means of direction finders as the flights progressed. Information gathered would be forwarded to NSA where analysts studied the communications and code systems used by the radar stations. NSA was then able to estimate the accuracy, efficiency and alertness of the target nation and was able to collect information about the command organization of the defense system.

ELINT missions, which are electronics intelligence flights by aircraft, were described as flying to the proximity of radar installations to obtain data about the radiations in order that electronic countermeasures (ECM) such as radar jamming could be devised.

Penetration and border flights were more frequent than generally supposed by the U.S. public, they said, citing the flight of an Air Force C-130 over the Turkish border into Soviet Armenia in September, 1958. The plane never returned. The U.S. claimed the plane was gathering scientific information and that the border crossing was accidental. The U.S. protested that the plane had been shot down without provocation, while a Soviet statement said only that the plane had crashed. Later the State Department released a recording of transmissions by Soviet aircraft which substantiated that the C-130 had been shot down (AW Feb. 16, 1959, p. 108).

On the day that the recording was released, the statement went on, USAF Lt. Gen. John Samford, director of the NSA headquarters at Ft. Meade, Md., spoke on the internal broadcasting system to some 10,000 employes saying

Vinson Launches Intelligence Probe

Washington—Rep. Carl Vinson (D.-Ga.) moved quickly last week to take command of the congressional probe that will inevitably follow defection to Russia of two National Security Agency mathematicians. House Armed Services Committee, which Vinson heads, launched a comprehensive investigation of Central Intelligence Agency and all Defense Department intelligence organizations.

Vinson, a long-time defender of the military services on Capitol Hill, claimed his committee has jurisdiction over intelligence matters and exercised this jurisdiction in an effort to head off a developing investigation by Rep. Francis E. Walter (D.-Pa.) and the Un-American Activities Committee.

A special Armed Services Subcommittee headed by Rep. Paul Kilday (D.-Tex.) will conduct the investigation. It is to look into intelligence agency methods for recruiting, screening, re-screening and clearing their personnel. The group also will investigate the defection of NSA employes William H. Martin and Bernon F. Mitchell. Other subcommittee members are Rep. Porter Hardy (D.-Va.) and Rep. Leslie Arends (R.-Ill.).

President Eisenhower supported a thorough review of security procedures, with the intention of improving them, at his press conference last week.

As Vinson was announcing the Armed Services Committee probe, Walter announced his committee will hold a closed hearing Sept. 16 on the Mitchell-Martin defection and on the previous defection of Army linguist Vladimir Sloboda. Witness scheduled is Maurice H. Klein, NSA personnel director.

One of the two defectors asked for and received information about the flight of a Lockheed U-2 reconnaissance plane that was downed near Sverdlovsk, Russia, last May 1, Walter said. He said the request was made before the flight occurred, but did not indicate when the defector received the information.

House Majority Leader John McCormack (D.-Mass.) asked Walter two weeks ago to investigate the disappearance of Mitchell and Martin. McCormack said then that he had information that the two men took valuable code information and a considerable knowledge of U. S. code machinery and procedures pertaining to Soviet and other foreign codes with them to Russia.

"There is also the possibility . . . that these two employes were in contact with Soviet agents since last December and could have easily turned over valuable information to the Communists in Mexico months before they turned up missing," McCormack said.

there was to be no discussion of the C-130 incident.

Nevertheless, the employes did discuss it among themselves, Martin and Mitchell said. Martin said a high NSA official told him that the aircraft carried electronics specialists and special equipment and flew across the border deliberately to seek out Soviet radar sites. Another official told Mitchell that the U. S. had a policy of overflights and that the U. S. had intentionally violated the borders of Communist China, the two said.

The point stressed by the defectors was that probing radar defenses has nothing to do with detecting a surprise attack but is done to determine the defense potential of the Soviet Union.

They picked Gen. Thomas S. Power, commander of USAF's Strategic Air Command, as an example of an advocate of preventive war, quoting in part from testimony they said he gave in support of the Fiscal 1960 budget to the effect that tremendous advantages accrue to the man who starts a war.

Mitchell and Martin said NSA's headquarters building at Ft. Meade is second in size only to the Pentagon and houses 10,000 employes. Of the half billion dollars allocated to NSA annually, $1 million goes for maintenance of headquarters, while $380 million supports a worldwide network of forward intercept stations and their operations.

The network, they said, includes more than 2,000 manual intercept positions run by more than 8,000 armed forces operators, with a smaller number operating radio teletype intercept equipment.

NSA headquarters has four main offices—Production (PROD), Research and Development (R/D), Communications Security (COMSEC), and Security (SEC), the defectors said. Office functions were described as:

• **PROD**—Perform cryptanalysis and other analysis functions on material received. This office is further divided into ADVA, specializing in Soviet cipher systems and diplomatic codes; GENS, Soviet military codes and medium ciphers; ACOM, Asian Communist countries codes systems; ALLO, systems of U. S. allies, neutrals and some Communist nations; MPRO, providing computing services.

• **R/D**—Divided into REMP, which conducts research in cryptanalysis and computer components; RADE, which designs receivers, transmitters and radio signature devices; STED, which studies weaknesses in crypto systems and equipment.

• **COMSEC**—Responsible for the production and security of U. S. cipher systems.

• **SEC**—Conducts personnel investigations of NSA employes.

The defectors indicated that NSA's success was due to the capabilities of expert cryptanalysts aided by digital computers.

Britain and the U. S. exchange personnel and information in the field of communications intelligence, they said, and close cooperation is also maintained with Canada.

In a related development, Premier Nikita Khrushchev told U. S. Ambassador LlewellynThompson, Jr., at a diplomatic reception in Moscow that he has secret information that the North Atlantic Treaty Organization powers are "planning a new provocation in September by sending a plane over the Black Sea" when NATO holds annual military maneuvers.

"But we are ready and the orders are out to shoot it down," Khrushchev said. Challenged by Thompson, he said the plane would be shot down only if it flew along Soviet borders.

Thompson said Soviet planes have flown over Alaskan islands and Soviet ships have cruised along the Alaskan coast. Khrushchev denied this and repeated his demand that the U. S. apologize for the U-2 flight. He again said he is convinced President Eisenhower did not know about the May 1 U-2 flight before it took place.

Khrushchev also repeated that the United Nations Security Council must take action against U. S. reconnaissance flights. Thompson reminded him that the U. S. had proposed impartial investigation of Russia's shooting down of a USAF RB-47 over international waters last July 1, but Khrushchev said: "This involves our sovereignty and we would never submit to anything like that unless you had crushed us."

NASA Changes Rules For Apollo Conference

Washington—Bidders' conference on planned National Aeronautics and Space Administration contracts to study feasibility of Project Apollo is expected to draw at least 78 industry representatives as the result of a switch in ground rules for the meeting.

Widespread interest in Apollo following industry briefing last month (AW Sept. 5, p. 26) has led NASA to open the conference, scheduled today at Langley Research Center, to all companies capable of defining and analyzing concepts for a spacecraft system carrying more than one man.

Initial plan called for restricting the conference to companies with the capability for building whatever system might be chosen from feasibility studies. NASA later concluded that opening the session to all companies would develop more approaches to the concept and provide a more accurate measure of industry interest and capabilities.

Proposals are due Oct. 10 at Space Task Group, where they will be evaluated by a team representing NASA headquarters, Goddard Space Flight Center and Space Task Group. Two or three contracts will be awarded Nov. 14, calling for completed studies by May 15.

Organization Changes Opposed by Lemnitzer

Washington—Gen. Lyman L. Lemnitzer opposed any basic changes in Defense Department organization during Senate hearings on his nomination for a two-year chairmanship of the Joint Chiefs of Staff.

Gen. Lemnitzer, who will take over the chairmanship Oct. 1, commented that "I believe that the total impact of the latest reorganization act is not yet clearly apparent. . . . I think that there are ample authorities within the present status of the defense reorganization act to provide anything that I might have in mind. . . . At the present time I have no recommendations for further reorganization." Testimony was released last week by Senate Armed Services Committee.

During the hearing, Gen. Lemnitzer:

• **Clarified** that Gen. Thomas S. Power, commander of Strategic Air Command and chief of the new inter-service targeting agency established to determine targets for Air Force and Navy strategic forces (AW Aug. 22, p. 36), "is functioning as a director of plans directly under the Joint Chiefs of Staff." Lemnitzer noted that JCS will establish the policies on which Power's plans will be based. He concurred with Sen. Richard Russell (D.-Ga.), committee chairman, that when Power's plans are submitted to JCS "they can accept them in part or all of it, or reject it completely and draw their own plans, and then submit them to the Secretary of Defense for approval.

• **Anticipated** a shift in emphasis from forces for massive nuclear retaliation to limited war capability. "I have advocated a greater emphasis on the ability to wage limited war," he observed. "I believe that emphasis is now taking place." He noted that all of the military services have "a prime, important and vital role to play in the conduct of limited war. . . ."

• **Advocated** that the chief of staff of a military service present his views personally to the Secretary of Defense or to the President, when they differ from a decision of the JCS or the Secretary, as the case may be, instead of via the JCS chairman. "I much prefer, and I heartily endorse the presentation of views at this level by the military head of the service himself," Lemnitzer said.

Communications Unit Considering 16 Bids

Washington—Defense Communications Agency has received proposals from 16 companies and teams for national military communications nerve center to be built here (See p. 71).

DCA hopes to narrow the list to three or four within 10 days, then ask for bids. Proposals are being considered from:

American Machine and Foundry Co. teamed with Control Data Corp., Stelma, Inc., Design and Production, Inc., and Lord Electric Co.; Teleregister Corp.; Alpha Corp. with Sperry Rand Corp.; Western Electric Co. with International Business Machines Corp. and Stromberg-Carlson Division of General Dynamics Corp.; Sylvania Electric Products, Inc.; Western Union with Technical Operations, Inc., Control Data Corp. and Hazeltine Corp.; and Laboratory for Electronics, Inc.

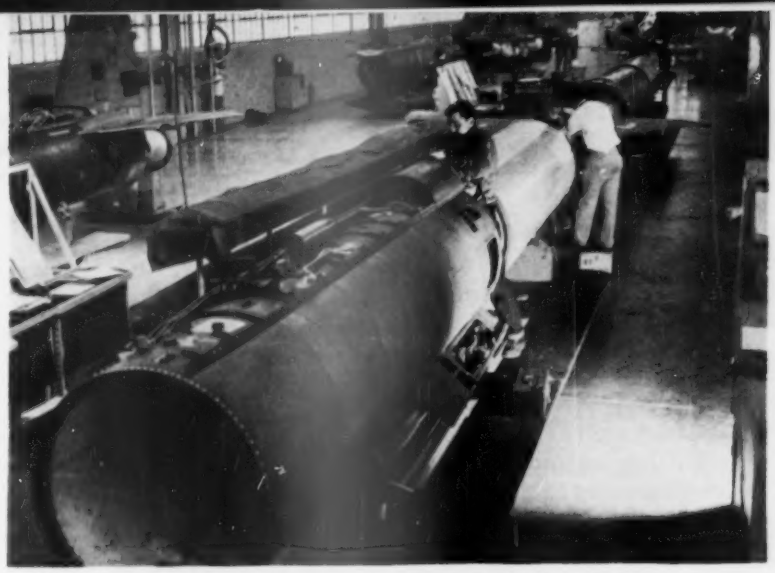
Also, Philco Corp. with Systems Development Corp., Hoffman Electronics Corp., and Dunlap and Associates, Inc.; General Electric Co.; Librascope Division of General Precision Corp.; Radio Corp. of America; Hughes Aircraft Co.; International Telephone and Telegraph Corp. with Thompson Ramo Wooldridge, Inc., and Davstrom, Inc.; Fenske, Fedrick and Miller, Inc.; Minneapolis-Honeywell Regulator Co. with Planning Research Corp.; and Electronics Division of ACF Industries, Inc., with Page Communications, Engleman and Co., and C-E-I-R, Inc.

Navy F4H Sets 500 km. Record of 1,216 mph.

Edwards AFB, Calif.—World record of 1,216.78 mph. for a 500 km. (310 mi.) closed course was set here in a Navy McDonnell F4H-1 Phantom II by Marine Lt. Col. Thomas H. Miller, exceeding the old record by more than 400 mph. The record was claimed on the fifth attempt, though all flights were better than the previous record of 816.3 mph. set in 1959 by a USAF McDonnell RF-101.

Navy will try again next week with the F4H to set a record for the 100 km. closed course. At current speeds the triangular 100 km. course of a little more than 20 mi. per side forces the aircraft to stay in a steep turn, actually flying a circle.

Col. Miller said every ounce of the 23,000 lb. full fuel load was needed to make the climb to altitude of 48,000 ft. and the 15 min. 20 sec. record run with afterburners on. In two earlier attempts afterburners had to be shut down and the effort abandoned to save enough fuel for a landing. Three external fuel tanks were carried in the climb to altitude.



Advanced Bomarc Readied for Test

First photo shows an IM-99B Bomarc interceptor missile being readied for functional test at Boeing Airplane Company's Missile Production Center, Seattle, Wash. Experimental models of the IM-99B have scored a number of successful interceptions in recent tests.

The record flights were made without the four dummy Sparrow III missiles usually carried in F4H flight tests. McDonnell and Navy officials said the airplane would probably have been cleaner aerodynamically with the missiles on, but removing them saved about 1,200 lb. of weight.

Paint was blistered and cracked by aerodynamic heating in front of the engine inlets, on the upper surface of the right aileron and on the rudder. The airplane used in the record run is the 12th off the line and is being used in performance tests at the Naval Air Test Center, Patuxent River, Md.

Col. Miller said the shortest leg of the triangular course was about 72 mi. long and 12-mi.-radius turns pulling a little over 2g were made at the pylons. Tighter turns would have been possible but would have bled off too much speed.

Air Force and Navy officials have recently expressed strong objections to a Department of Defense directive which requires that a military aircraft be operational six months before being permitted to try for an international record certified by the FAI. They point out that in almost every instance a waiver must be requested from DOD to permit a record attempt by a prototype aircraft such as the F4H-1. In effect, they argue, the directive has gone by the board, yet time-consuming administrative procedures must be followed to obtain the standard 90-day period for setting a record.

News Digest

Workers at United Aircraft's Sikorsky Division last week voted to work without a contract, ending a long strike. An independent group has petitioned for a National Labor Relations Board election to determine if United Auto Workers union will remain the bargaining agent (AW July 25, p. 34).

Geophysical satellite proposals for prototype 1,000-lb. system are due Sept. 26 at NASA's Goddard Space Flight Center, with contract award scheduled late this year.

First radio wave reception from the planet Saturn has indicated a surface temperature of minus 280F, University of Michigan scientists reported in London last week. Working under an Office of Naval Research contract and using a radio telescope with a ruby Maser amplifier, the scientists also have received for the first time emissions from a planetary nebula, 3,000 light years away.

USAF-North American Hound Dog missile, fired by a B-52 for a test flight of several hundred miles to a target near Cape San Blas, Fla., went off course due to "a freakish combination of system failures" and crashed on a farm near Samson, Ala., last week. Repeated attempts by the range safety officer to destroy the missile failed.

Trans World Airlines directors met again last week, but adjourned without taking action on TWA's $340 million financing package or on selection of a new president. No further meetings are scheduled until the regular monthly board meeting at the end of September.

Small Carriers Seek Larger Voice in IATA

More representation asked on executive committee; lower fares urged through reduced operating costs.

By L. L. Doty

Copenhagen—Sixteenth annual general meeting of the International Air Transport Assn. opened here today with a drive by small carriers to increase their representation on the organization's powerful executive committee looming as a major issue of the five-day session.

At the same time, opposition to a plan that would tighten executive committee control of the IATA Traffic Conference and the Traffic Advisory Committee appeared to be growing. Strength of the smaller carriers will be put to a test later this week when nominations for this year's vacancies on the executive committee are placed on the floor of the assembly.

A number of IATA members have felt for several years that the executive committee has been traditionally dominated by a few large airlines since 1946 when IATA was reorganized. They charge that positions on the executive committee have been virtually self-perpetuating since airline members of the committee renominate themselves as each term expires.

The present move is the first significant attempt smaller carriers have made to unseat larger carrier membership as a means of winning a stronger voice in IATA decisions.

Protests against the plan to revamp the Traffic Conference also stem from fears that the change will give the executive committee too strong a control over conference decisions. Essentially, the proposed plan calls for the replacement of an annually-elected Traffic Conference chairman with a permanent chairman who would be an IATA employe or official. In addition, the executive committee wants to strengthen the Traffic Advisory Committee by revising procedures so that its chairman will report directly to the executive committee rather than to the IATA traffic director, which has been the practice since 1952.

In this connection, resignation of John Brancker as traffic director last month (AW Aug. 8, p. 47) will be raised as an issue although it is now considered unlikely here that attempts to restore him to his former position will be successful. Brancker was asked to resign by Sir William Hildred, director general of IATA. Hildred won at least partial support of the executive committee in his action although it is being stressed here that the committee decision was not a judgment of Brancker's competency but was based on the principle that Hildred carries the right to make his own staff decisions.

Because a number of carriers are eager to vouch for Brancker's abilities as traffic director, the forced resignation will be brought on the floor as a controversial issue.

In his opening address at the plenary session of the annual meeting, Hildred made no mention of the proposed change in the conference chairmanship but lent strong support to the conference structure as it now exists. This led many observers to feel that the plan will be temporarily shelved or turned over to the Traffic Advisory Committee for study.

Admitting that a number of IATA members feel that the Traffic Conference processes came close to "collapse" during the Honolulu meetings last year (AW Oct. 12, p. 40), Hildred said he wanted to see a continuance of the present system of multilateral negotiations on fares and rates among carriers with final government approval. He did urge that carriers practice more compromise in these meetings as a means of preventing deadlocks such as that which threw the Honolulu conference into stalemate to threaten an open-rate situation.

The executive committee will also propose to the assembly later this week stiffer enforcement regulations. Already, the committee has approved a doubling of the IATA enforcement staff as a means of enforcing closer conformance to IATA regulations. Question of whether maximum fine for rule infraction should be increased from $25,000 to $50,000 will be raised during the meeting. Consideration also will be given to proposals for the establishment of machinery that would permit a process of appeal on fines for carrier members.

Hildred alluded to bilateral negotiations in his opening address and noted that talks on bilateral air transport agreements "are becoming more difficult and even bitter. . . ." With respect to the problem of seat capacity, which in recent months has been the source of wrangling between the U.S. and at least five other countries, Hildred warned against the dangers of imposing a "strait-jacket of arbitrary and fearful regulation on capacity."

He urged that carriers allow the laws of supply and demand to determine proper capacity, noting that increased capacity can prime the pump for more traffic. Concurrent with the annual meeting, the U.S. today opened negotiations with the Scandinavian countries here on capacity problems. The U.S. is represented by Edward Bolster of the State Department and Civil Aeronautics Board member G. Joseph Minetti.

Hildred again called for lower fares as a means of generating traffic and opening new markets to the airlines. He cited the traffic growth on the North Atlantic following the introduction of economy fares as an example of traffic development through low rates. Hildred proposed operating cost cuts as the only logical means of lowering rates while retaining profits and avoiding government subsidy. Admitting that operating costs have climbed 280% in the past 10 years, he suggested that economies can be brought about in these areas:

- **Fuel costs.** Hildred said that approximately 16% of all airline expenditures is used for fuel. He added that the development of new specifications for fuels, new methods of measurement and new fueling procedures could result in taking off a "sizable bit" from the price of an airline ticket.
- **Communications costs.** Hildred said IATA was working jointly with the Air Transport Assn. toward standardization of interline teletype messages. Linked with computer systems for reservations control, the standardized system could result in cost reduction in ground communications, he said.
- **Navigation costs.** Hildred told the IATA delegates that use of the doppler radar navigation systems will decrease reliance on ground stations and allow airlines to "substitute payload for the thousands of gallons of reserve fuel they must often carry to compensate for possible navigation error—and perhaps cut another penny off the price of a ticket."
- **Flight costs.** He called upon govern-

ments to reduce the size of large volumes of restricted airspace which force diversions from direct routes, particularly over the North Atlantic. In his annual report to the meeting, Hildred predicted that the scheduled airlines of the world—both domestic and international—will carry over 100 million passengers this year compared with the 97 million carried in 1959. He added that North Atlantic passenger traffic handled in 1959 rose 19% over the volume carried in the previous year. He said cargo climbed 46% in the same period and that mail volume was increased by 15%.

Hildred warned that carriers face a glutted used-plane market and estimated that the industry will be saddled with as many as 1,800 surplus piston-engine aircraft by the end of 1961, many of which, he said, will not yet be fully depreciated.

With respect to pooling and economic cooperation agreements between airlines, Hildred admitted that such agreements are the airlines' only defense against demands for capital and maintenance, overhaul and supply costs for jet operations. He had this to add:

"But we must not forget that the public has other requirements and desires besides those of cost; and that they will avoid any tendency to underschedule and to diminish that touch of individuality in service which helps to keep air transport interesting, progressive and dynamic."

He stressed the growing problem of aircraft noise, noting that the industry has spent over $50 million in the development and installation of noise suppressors on jet engines. In addition, he said, the airlines sacrifice a quarter of a ton of payload per flight by using the engine noise suppressors. He called for better community relations in handling the noise problem and asked for zoning regulations which would prohibit the building of residences around airports.

On the subject on tourism, Hildred estimated that expansion of international air travel resulting from lower fares brought $6 billion into the channels of international exchange during 1958. He said this flow of currency meant foreign exchange earnings of $491 million for Italy, $454 million for France and $432 million for Britain.

First session of the general annual meeting was opened by Prime Minister Vigge Kampmann of Denmark. King Frederik and Queen Ingrid attended the opening plenary session of the meeting, which is being held at the Falkoner Centre here. Ake Rusck, president of Scandinavian Airlines System, the host airline, took office as president of IATA, succeeding Seijiro Yanagita, president of Japan Air Lines. Next annual meeting will be held in Sydney, Australia.

USAF Awards Airlift Contracts Under New Policy of Negotiation

By Katherine Johnsen

Washington—Air Force has divided $9.3 million in three-month Military Air Transport Service contracts for passenger service among 11 carriers under its new policy of using negotiated contracts instead of competitive bidding.

In awarding the contracts, USAF reluctantly accepted a minimum rate of 2.9 cents per passenger mile imposed by the Civil Aeronautics Board. The Board forewarned Air Force that it would not grant tariff exemptions to carriers with contracts below this rate.

In accepting the 2.9 cent floor, Air Force Secretary Dudley C. Sharp notified the Board that this would substantially increase MATS' commercial contract costs and necessitate a shift of planned contract business to MATS' own aircraft. Sharp observed in a letter to CAB Chairman Whitney Gillilland: "If award must be made on a 2.9 cent basis, MATS, because of appropriations limitations, will have no alternative than to move passengers who are presently programed for commercial carriers on MATS aircraft." He reported that bids as low as 2.01 cents a passenger mile had been received.

Sharp said that the initial bids of the international route carriers were at the 2.9 cent rate, but that the bids of other carriers were "significantly" less, making an average of 2.43 cents. If the awards for the three-month MATS passenger traffic were made at this average, Sharp told the CAB, the total cost would approximate $7.6 million. This would be about 20% less than the $9.3 million cost at the 2.9 cent rate. The average for Fiscal 1960 contracts was 2.12 cents a passenger mile.

The only carriers qualified—by virtue of airlift commitments to the Civil Reserve Air Fleet—which did not receive a slice of the $9.3 million in MATS awards were: Alaska Airlines, Resort Airlines, Trans-Caribbean Airways, and Northwest Airlines. Northwest's bid was over the 2.9 cent rate.

With carriers bidding approximately the same price, USAF gave preference to those operating turbine-powered aircraft, convertible aircraft and aircraft with overfly capability, in that order, in line with its policy of encouraging modern airlift capability. The awards went to:

- **Pan American World Airways,** $1.9 million. 5,278 passengers California-Japan via Honolulu and return.
- **Trans World Airlines,** $1.7 million. 7,755 passengers McGuire AFB, N.J.-England-France-Germany and return.
- **Flying Tiger Line,** $1.4 million. 3,366 passengers California-Okinawa via Honolulu and return.
- **Slick Airways,** $1.1 million. 2,970 passengers California-Japan via Honolulu and return.
- **Overseas National Airways,** $795,462. 1,743 passengers California-Philippines, via Honolulu and return.
- **World Airways,** $604,745. 1,672 passengers California-Guam, via Honolulu and return.
- **U. S. Overseas Airlines,** $551,354. 2,464 passengers California-England-France-Germany and return.
- **Seaboard and Western Airlines,** $435,780. 3,895 passengers England-France-Germany-U.S. East Coast.
- **Capitol Airways,** $319,915. 855 passengers Japan-California via Honolulu, and 475 passengers California-Hawaii.
- **Hawaiian Airlines,** $347,679. 1,008 passengers California-Japan via Honolulu.
- **California Hawaiian Airlines,** $80,355. 510 passengers California-Hawaii and return.

Detailing the additional cost to MATS of the 2.9 cent rate, Sharp pointed out in his letter to CAB that this means $215 for a round trip from the U.S. East Coast to Europe, compared with a proposed award of $189 and with the Fiscal 1960 cost of $155. The California-Japan round-trip cost of $391 compares with a proposed award of $301 and a Fiscal 1960 cost to MATS of $253, Sharp reported.

At 2.9 cents per passenger mile, the round-trip California-Okinawa rate is $444, compared with a proposed award of $329 and a Fiscal 1960 cost to MATS of $284. The cost of $456 for a California-Philippines round trip at the 2.9 cent rate compares with a proposed bid of $318 and a Fiscal 1960 cost to MATS of $303.

Two congressional groups are closely watching the results of MATS' new negotiated bid policy for commercial contracts:

- **House Armed Services Subcommittee** on airlift, headed by Rep. L. Mendel Rivers (D.-S. C.). Rivers is opposed to the 2.9 cent rate "arbitrarily forced on the Air Force," largely because of the additional cost it will mean to MATS.
- **Senate Small Business Committee,** headed by Sen. John Sparkman (D.-Ala.). Sparkman is apprehensive that the new policy might lead to the elimination of supplements and small carriers from MATS business, and has asked Sharp for information as to what the policy will be on set-asides for small business.

Dear American Airlines:
I average 50,000 miles per year on commercial airlines - so I recognize good service when I see it. My flight was made unusually pleasant – thanks to your Miss Clare Vize and Miss Valerie Franks. I'd like to have them in my public relations department!
W. E. Uzzell

UNSOLICITED IN-FLIGHT LETTER FROM MR. W. E. UZZELL, V. P. OF ROYAL CROWN COLA CO., COLUMBUS, GA.

Our Stewardesses, Mr. Uzzell, are another reason why American Airlines is first choice of experienced travelers. We choose just 1 in 23 from over 15,000 annual applicants for an intensive 77-subject course at our Stewardess College, the only one of its kind. The young ladies graduate with honors in the gracious art of making people happy.

AMERICAN AIRLINES
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Landis Stumps for ALPA Decentralization

By Michael Yaffee

New York—Decentralization of authority and more expert leadership and professional assistance emerged as the dominant goals of James M. Landis' campaign for the presidency of the Air Line Pilots Assn., which got under way here last week.

At a meeting attended by representatives from approximately 16 of ALPA's 27 New York area councils, Landis asserted there is too much centralization of authority in ALPA, and that a much more efficient job could be done in all areas of pilot representation if greater authority and representation were delegated to ALPA's five regional levels. Specifically, it was argued, this would enable local councils to provide their members with more professional and better public relations and more expert and effective legal assistance and representation before government bodies.

The New York meeting was called by the Landis-for-President group here in an effort to obtain support for Landis among the local councils. Because Landis, a former dean of Harvard Law School and ex-chairman of the Civil Aeronautics Board, is not a pilot, ALPA by-laws specify that he must obtain the backing of two-thirds of ALPA's 300-man board of directors (made up of the chairman and a senior pilot from each of the local councils) in order to have his name placed in nomination for the presidency at the association's convention in November.

Only Council 18 (Eastern Air Lines council in Miami) has formally adopted a resolution to put Landis' name in nomination. In New York Landis is being backed by some members of Eastern Air Lines Pilots Council 51 including Council Chairman Jack Young. Young could be sent to the convention instructed by the 500 members of his council to back some other candidate instead.

Both Young and Thomas Crane, a vice chairman of Council 51 and chairman of the New York local Landis-for-President group, report an undercurrent of support for a change in ALPA leadership and for Landis among many of ALPA's 16,000 members that they have queried. Clarence L. Saven, president of ALPA since 1951 and the man whom Landis would probably be running against in November, has made no specific reply to Landis.

As part of his campaign, Landis will travel next to Florida this week or next to talk to pilots in the Miami area. From there, he plans to go to the West Coast to talk to pilots in Los Angeles and San Francisco.

Neither Landis nor the various pilots who are supporting him are taking exception to stands by present ALPA leadership on any recent issues. But strategy and timing of these stands have been way off the mark, they say. As one pilot pointed out at the meeting, "We haven't won a battle yet." "We have come out on the short end of everything from court actions to press notices," another pilot said, "and it's nobody's fault but ALPA's." Among the specific charges leveled at ALPA leadership:

- **Pilot's side** of the 1956 pilot-flight engineer controversy was never fully and properly told.
- **Timing of ALPA's action** in the Southern Airways case this year was too late and therefore ineffective.
- **In the walkout** of pilots last June in connection with the third seat controversy, pilots' story was not presented properly and ALPA action was late and ineffective.
- **Poor representation** and public relations led ALPA to defeat in its fight against mandatory retirement at age 60.

There should have been no walkout over a technical issue of the matter of safety involved in permitting an FAA inspector to ride in the third seat, pilots at the New York meeting asserted. ALPA should have sought an injunction immediately, staying Quesada's order pending investigation. Instead, the matter started to snowball, and before the present centralized ALPA leadership could provide proper direction, it got completely out of hand, the pilots said.

In the Southern Airways case, Landis said, ALPA should have made its move as soon as it discovered Southern planned to hire non-union pilots and not waited two months. By then, Southern had already committed itself to a policy of placing returning ALPA pilots at the bottom of the seniority list behind the non-union men. ALPA should have tried to bring pressure to bear while Southern's request for a mail rate increase was pending before the CAB, he said. It should have pointed out that hiring non-union pilots involved considerable expense for living quarters, training and checkout and that money from a government subsidy should not be used to help the company defray this expense.

At the New York meeting, the Landis-for-President group presented a formal program formulated under the guidance of James M. Landis. Among

FAA Issues Idlewild Noise Rule

Washington—The Federal Aviation Agency issued its noise abatement rule for New York's International Airport last week, but did not include in its contents some key recommendations of the Port of New York Authority, the terminal operator.

When FAA solicited comments last spring on its proposal, the Port Authority suggested that night turbojet takeoffs be barred on all runways except 22 and 25, which point aircraft over water. It also urged that a "maximum permissible noise level" of 112 "perceived noise decibels" be set for departing aircraft.

In effect, this requirement would force airlines to limit the weight of departing aircraft so that they would climb rapidly enough to avoid exceeding the 112 PNDB limit. In some instances, an economic penalty would be imposed on the carriers.

Neither Port Authority suggestion was written into the FAA regulation, which is effective Oct. 15. But the Port Authority has set its own noise rules for Idlewild, and these contain the two recommendations that FAA chose not to adopt. The Port Authority rules will continue in force unless challenged by FAA.

In issuing its anti-noise rule, FAA said that suggestions such as those made by the Port Authority were "not compatible with the critical need in the New York area for air transportation services." It also said that there was insufficient evidence to determine whether the noise benefits derived would justify the burden placed upon the airlines. FAA did modify its list of preferential runways to permit more operational flexibility. The FAA regulation also:

- **Requires aircraft operating in the New York International Airport traffic area to maintain two-way radio communication with the appropriate facility—center, tower, approach or departure control.**
- **Sets a traffic area entry altitude of 1,200 ft. or higher, and an operating altitude of from 1,000 to 1,200 ft., for light aircraft flying within five miles of the terminal.**
- **Refuses to distinguish between "light" and "heavy" turbojets in fixing preferential runways. This distinction, FAA points out, is at the discretion of local air traffic control authorities.**
- **Orders large aircraft, all those above 12,500 lb. gross weight, to enter the airport area at an altitude of at least 1,500 ft. above the surface and to maintain such altitude until maneuvering for a landing.**

PROBLEMS? OR PROFITS?

Route pattern complexities of typical airlines demand a cargo aircraft with the capability of operating over both short and long route segments with excellent economy and earning ability. The Canadair Forty Four will do this for you! It combines the air cargo feeder liner with the long range aircraft to provide a standardized economic fleet unit. The Forty Four will give you profit-making operations, at current rates, over route segments as short as 200 miles and as long as 4,000 miles.

This is the type of flexibility that will answer the many and varied problems confronting airline operators who, because of the growing demands of shippers, are being forced to provide a combination of short, medium and long range air cargo services for the carriage of freight at attractive and competitive tariffs. In this situation, the Canadair Forty Four offers excellent economy and earning ability over the complete range of route structures that must be provided in the collection and distribution of air cargo.

Practical applications of this are found in the short route cargo services that are necessary in the supply and distribution of goods to or from the terminal points of transcontinental and trans-Atlantic services. This is evident between the major cities of the Eastern United States and between the principal points of Europe. These inter-city runs are essential extensions to the long haul trunk service, and with the Forty Four can be handled without a change of aircraft.

The need for this system of short, medium or long range operations will develop through the growing awareness among business establishments that the carriage of articles by air is becoming an essential element in the overall marketing function. This will open up new markets, new transportation requirements, new inter-city services. The Forty Four, with its flexibility of performance, can carry cargo at a profit over the whole distance spectrum—short, medium and long range, and has the airfield performance characteristics to get in and out of 85% of the world's major airports. THESE ARE DECISIVE ADVANTAGES IN FAVOR OF THE FORTY FOUR.

SOME RUNWAY AND PAYLOAD SPECIFICS ON THE FORTY FOUR-D4

1. From runways as short as 6,000 feet, can operate with 70% payload up to stage distances of 3,000 miles.
2. Can operate from 85% of the world's major airports, with due consideration to both runway length and allowable wheel loading.
3. Will earn an operating profit with load factors as low as 30%.
4. Breakeven load factors in the Forty Four represent loss loads on larger proposed equipment.
5. Breakeven load factors on larger proposed equipment represent major profit payloads on the Forty Four.
6. Can operate *non-stop* on the London-New York route with an average annual payload of over 55,000 lbs.

CANADAIR LIMITED, MONTREAL, CANADIAN SUBSIDIARY OF **GENERAL DYNAMICS**

Landis' platform recommendations:

• **Amend headquarters** functions to provide: (A)—control and assistance to regional units on nationwide policies; (B)—professional representation to supervise and handle all contract negotiations; (C)—assurance that all contract negotiations begin on stipulated date and continue uninterrupted until agreement is reached; (D)—continuous and effective Washington representation with the Civil Aeronautics Board, the Federal Aviation Agency, and other government agencies and (E) all-out assistance on a nationwide basis to members on strike, this help to include funds and advice.

• **Adjust the wage structure** of the piloting profession to reflect: (A) increased responsibility, which has relationships to greater productivity, (B) cost-of-living increases, (C) better achievement by the pilot group as compared with others of the nation's labor and professional organization, and (D) recognition of the professional requirements of the present-day airline pilot.

• **Achieve changes** in working rules to assure adequate and proper rest periods, as necessitated by additional strains resulting from operation of faster, more demanding equipment.

• **Provide stabilized level** of employment, and create a national agency within ALPA, covering all forms of pilot employment research, development, commercial—which maintains most complete and up-to-date listings.

• **Provide adequate furlough** protection, necessitated by such factors as: (A) reduction in pilot force and (B) technological unemployment.

• **Provide adequate income** protection necessitated by forced or premature retirement due to physiological aging rating or physical disability.

USAF Ferries Troops From India to Congo

Wiesbaden—A second contingent of Indian personnel has been alerted for Congo duty. USAFE 322nd Air Division headquarters at Evreux, France, reports 14 cargo planes were sent to New Delhi to begin movement of a total of 462 personnel and 153 tons of medical supplies to be completed in two segments.

In mid-August the first contingent of 91 Indian supply personnel and 3½ tons of cargo were moved by USAF to Leopoldville. Ten Douglas C-124 Globemasters and four Lockheed C-130 Hercules are scheduled to begin the bulk of the new operation Thursday, Sept. 7. Included in the airlift are 326 men and 148 tons of medical supplies. Balance of the requirement for 136 people and 5 tons of equipment will be carried by two C-130s on Sept. 20.

Garrett Proposes Solutions To Mach 3 Transport Cabin Problems

New York—Vapor-cycle cooling, stored-air pressurization and ram air emergency pressurization are among the elements of a supersonic transport passenger environment system proposed by two scientists of The Garrett Corp.

Cabin windows are definitely in the Mach 3 transport cabin described by James N. Waggoner, medical director of Garrett, and Paul A. Elkins, environmental systems group supervisor, preliminary design. In a joint report discussed at a conference here last week, the two Garrett officials listed these requirements of a safe and comfortable cabin system:

• **Cooling system would maintain** 70 to 80F by means of bottled liquid oxygen and nitrogen, supplying makeup air to a vapor-cycle system transferring heat to an intermediate fluid such as ethylene glycol. This fluid in turn passes the heat to engine fuel. Cabin wall temperatures only 10 to 15 deg. above cabin temperatures will be maintained by use of perforated walls, despite fuselage skin temperatures of 450F and ram air stagnation temperatures of 650F. Total heat to be rejected from the cabin at Mach 3 cruise is 300,000 Btu. per hour.

• **Pressurization will be provided** at a 70,000 ft. altitude equivalent to 5,000 ft. by means of a stored-air system. Emergency pressurization would be provided by ram air flow, and the ram air would be cooled to about 100F during descent by heat transfer using about 150 lb. of water. The cabin would be equipped with a large number of small windows. Windowless cabins, Waggoner said, would be absurd and unrealistic.

• **Boundary layer noise** will average about three times the surface pressure level of subsonic aircraft, or about 132 db. for the Mach 3 plane. More and better attenuation materials must be used in the fuselage, as well as a skin structure resistant to noise-induced damage.

• **Ozone belt** through which the Mach 3 jets would be flying might affect flight crews, but ozone levels can be reduced to tolerable levels by filtration and compression. Radiation levels are considered well within limits of safe dosage.

Alloy Stresses

A Mach 2 to 2.4 airplane is possible immediately, according to the Garrett scientists, but might shortly become obsolete because its aluminum alloys would be stressed to their maximum heat tolerance and could not accept more powerful engines if they became available. But the stainless steel-titanium structure needed for the Mach 3 plane could accept the heat of still-higher speeds. Waggoner also pointed out that beyond Mach 3, the time advantages of further speed capability are far less than the advantages of moving from Mach 2 to Mach 3.

Development Assured

Elkins called development of a 2,000 mph. transport within the next 5 to 10 years "a virtual certainty." The Garrett scientists, replying to a question, said the scope of the North American B-70 program would determine where in that time period the development would occur, but that in any case 1970 would see the accomplishment.

AiResearch Manufacturing Division of Garrett has built a closed environmental control system for the Project Mercury capsule.

WADD Conference On Supersonic Transport

Washington—Wright Air Development Division held a technical conference on design problems of supersonic transports last week, with eight companies invited to attend the meeting and submit proposals for design study programs within six weeks.

On the basis of the study proposals submitted by the contractors, the Air Force will select at least one firm to perform a detailed study of the design problems of supersonic transports over a wide spectrum of cruise Mach numbers, payloads and ranges. Contracts would cover several months of work. Their dollar value has not yet been specified.

Primary purpose of the study is to bring past preliminary design work on a supersonic military cargo-personnel transport up to date in light of recent information on aerodynamics, structures and materials. Commercial attractiveness of an aircraft meeting the military requirements will also be investigated. Results of these studies will be used by the Air Force during discussions of a possible national supersonic transport development program which would meet both airline and military needs.

Companies invited to the conference were Republic Aviation Corp., Convair Division of General Dynamics Corp., Lockheed Aircraft Corp., Douglas Aircraft Co., Boeing Airplane Co., Nor-Air Division of Northrop Corp., North American Aviation, and McDonnell Aircraft Corp.

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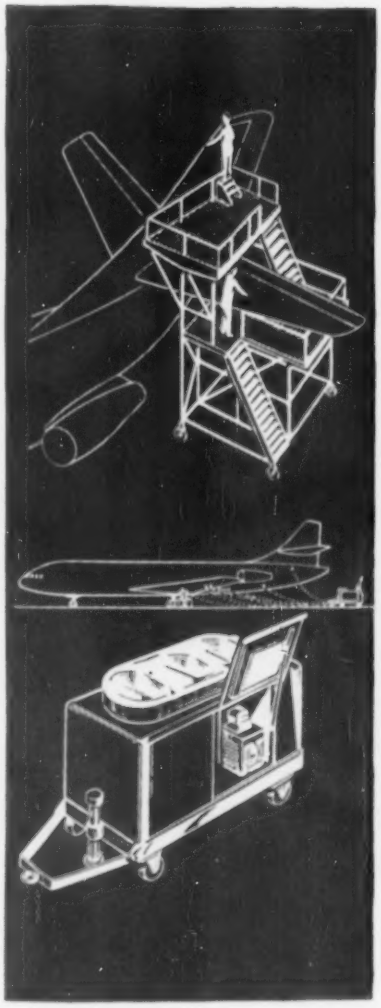

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Traffic Gain Light in Rail Strike

New York—Closing down of the struck Pennsylvania Railroad had no great effect on airline passenger traffic over the Labor Day weekend, although carriers serving the New York-Washington routes were standing by with extra capacity in case a rush developed.

In general, passenger traffic out of New York was reported at about the same level reached over last year's Labor Day holiday. Few extra sections were actually flown. American Airlines reported a sharp increase in New York-Washington passenger volume on Sept. 1 and 2, just after the strike began, and added three extra sections. However, plans to add additional capacity over the weekend as needed were not necessary.

Eastern Air Lines said its passenger business was about equal to that of last year. No extra sections were operated.

National Airlines could detect "no great effect" from the Pennsy strike, but experienced a 23% traffic increase out of New York over the four-day period. Capacity increase was 5.3%. Only one extra section was flown.

Northeast Airlines reported seats available on the New York-Washington run despite the railroad strike. There was an increase in demand, but no-shows left seats to accommodate anyone who turned up for a flight. Traffic was up about 10-15%.

At Washington, Capital Airlines added 10 sections over the holiday but doubted that the rail strike accounted for much business. Passenger miles sold totaled 16,104,000, up from 15,687,000 during the same period of 1959. Passenger revenues went from $992,000 to $1,040,000.

Allegheny carried 8,662 passengers, up from 6,812, but said most were booked in advance and not diverted from the Pennsy.

Big gains in airline carriage of first-class non-priority mail, however, have resulted directly from the Pennsy shutdown. Under temporary emergency authorization from the Post Office, movement of first-class mail from many new points is taking place. Last Wednesday, American carried double its normal first-class mail load out of Idlewild, and volume out of LaGuardia increased 50%. Eastern picked up a number of new cities under the emergency authorization, including points in New England, the Midwest and the Southeast.

Airline spokesmen pointed out that the emergency use of airlift for the first-class mail should help with their campaign for extension of the first-class mail by air experiment. Another area of interest to the carriers was potential air freight business that might be wrested from the railroad while it was out of action. Some carriers reported sales efforts directed to this end, but results to date have been inconclusive. The effect on passenger traffic is admittedly difficult to measure, too, because railroad tickets are not negotiable on the airlines.

Local Subsidy Criticized

Washington—Civil Aeronautics Board's recommendation for North Central Airlines route extension from North Dakota to Regina, Saskatchewan, Canada, was rejected by the White House last week on grounds that the Board failed to offer enough evidence that the route could be operated without an excessive increase in subsidy.

President Eisenhower expressed concern over the increasing cost of government subsidies to local service airlines and stated that the Board's findings in the Service to Regina Case failed to give sufficient details to assure that the airline could build enough traffic volume over the Minot, N. D.-to-Regina route within a three-year period to satisfy CAB's use-it-or-lose-it policy, or that such an operation could become self-supporting.

Pointing to the possibility that operation of the route might result in an excessive subsidy increase for the airline, the White House letter urged CAB to intensify its efforts to review and overhaul the certification and subsidization of local service airlines.

At the same time, the White House permitted CAB to give North Central two other routes into Canada because the Board said they would be either self-supporting or require little subsidy. They are routes to Pt. Arthur/Ft. William, Ontario, from Duluth, Minn./Superior, Wisc. and from Hancock/Houghton, Mich.

Bankruptcy Petition Filed Against Southern

Washington—An involuntary bankruptcy petition, filed against Southern Airways last week by pilots who have been on strike since June 5, was labeled "harassment" by the carrier.

Three of the company's 147 striking pilots filed the petition with the U. S. District Court in Atlanta, claiming that money owed them by the airline makes them creditors who are "in a sense subsidizing Southern's attempted strike breaking."

Captains Benjamin Epps and Robert T. Brown, along with Air Crews Service, Inc., a Jacksonville, Fla., car rental agency, contended that Southern is financially insolvent and had been settling some of its debts but was not attempting to settle others. Epps presented a claim for $525, Brown for $384.71 and the car agency, owned by a striking Southern pilot, a bill for $1,520.28.

Southern attorneys were given 15 days in which to reply to the petition, and spokesmen for the carrier discredit the petition claims on the grounds that Southern is not only financially solvent, but has continued to expand its operations to a normal level of service despite a strike that is now over three months old. The carrier now employs 120 non-union pilots and expects to have 81% of its regularly scheduled aircraft miles restored by the end of this week.

Meanwhile, Southern said it fully intends to pay any of these claims which it considers a valid bill, even though due bill notices were not served upon the airline prior to the petition filing.

Capt. Brown's claim, the company said, involves an issue of back pay which Southern feels is not valid, while the remaining two claims are carried as accounts payable on the airline's books and will be settled.

Los Angeles Airways Accepts Sikorsky S-62

Stratford, Conn.—Los Angeles Airways last week accepted delivery here of a Sikorsky S-62, expected to go into service in a few weeks as the first turbine-powered helicopter in certificated airline operation.

The amphibious aircraft has been leased from Sikorsky by Los Angeles Airways. It will serve, the airline said, as interim equipment pending delivery of five 28-passenger, twin-turbine S-61s LAA has on order from Sikorsky for delivery beginning next year. The S-62 holds 9-12 passengers, costs $300,000.

The S-62, powered by a single General Electric T58 engine, cruises at about 100 mph. Los Angeles Airways expects to use its single S-62 to gain turbine experience. The aircraft will go onto a high density route segment. The boat hull will not be put to use since the routes will be over land.

Los Angeles Airways now operates five Sikorsky S-55s with a seven-passenger capacity, as well as two S-51s. The S-55s will be sold when the S-61s are delivered, and possibly the S-62 will be turned back to Sikorsky. According to Sikorsky, no trade-in arrangement for the S-55s has been negotiated.

According to the manufacturer, there are 10 firm orders for the S-62 at present. Sales Manager J. E. Beighle said there are good prospects for sales to groups in San Francisco and Washington, D. C., for air taxi operation.

Airlift Moves 5,000 to Dealer Meeting

Dallas, Tex.—Nine scheduled U.S. and Canadian airlines successfully transported some 5,000 dealer personnel and special guests of farm equipment manufacturer Deere & Co. to a one-day sales meeting here without incident.

More than 3,500 of the Deere contingent were brought into Dallas aboard chartered airliners; the remainder occupied seats on flights regularly scheduled into Love Field. The entire operation was coordinated by a handful of United Air Lines personnel who worked with the company and other airlines in the airlift operation for approximately one year before it took place.

Deere & Co., which began planning its first meeting of the complete dealer organization in one place at one time some 18 months ago, spent an estimated $1,250,000 on the operation, which was carried out with almost military security-type measures to ensure maximum success and minimum interference from organizations which might attempt to exploit the gathering. Deere personnel attached to the show's planning staff and United Air Lines represented themselves as employes of Wilding Pictures, a Chicago firm that produces industrial films for Deere and other industrial customers.

Airlift Team

United Air Lines was approached just over a year before the airlift and asked if it could handle transportation for approximately 5,000 persons to Dallas in one day. United Air Lines organized a team under the leadership of special incentives and programs manager Harry Horst to provide national coordination for the airlift. UAL representatives contacted high-ranking personnel in the major scheduled airlines and explained the problem, without mentioning the customer's name, asking the carriers to supply estimates of the type of transportation and schedules that they could arrange from the various pickup points to Love Field. It had been decided that the maximum success and coordination of arrival and departures depended upon funneling all the passengers through one airline terminal.

As the plan developed, a map of the U.S. and Canada was broken down into regions representing Deere dealer locations.

These were further organized so that there were 96 staging cities into which the passengers would funnel to meet their airlift.

As these became known, the operation was broken down and parceled out among the nine carriers involved—American, Braniff, Canadian Pacific, Continental, Delta, National, Northwest, Trans-Canada and United. In bringing Deere people into the staging points and then to Dallas, a total of over 100 scheduled flights and 60 charters were required. Of these, the final transport into Dallas involved 30 scheduled flights and 46 charter airplanes.

Facilities Checked

Top officials of the participating airlines only learned of the customer's true name last April—in July, United coordinators began informing personnel of airlines involved at points of anticipated arrival of the group.

Deere personnel began to check facilities at each of the pickup points so that they would be familiar with the airports and be able to guide their passengers, and also to ensure that proper ground handling facilities would be available. At one airport, for example, where a charter transport was to pick up a group, it was ascertained that there was no engine starting equipment for the type of airplane that would be needed.

This necessitated that the airplane keep its engines running between the time it was scheduled to arrive and passenger boarding.

UAL notes that nearly every type of airplane, from Douglas DC-3 to Convair 880, was involved somewhere in the airlift.

One section of the airlift involved a Delta charter DC-8 that picked up 118 dealers and guests at Detroit, flew them to Dallas, then turned around and flew to Chicago where it loaded 80 persons who had staved at that city plus 40 who had come in from Lansing via Capital Airlines and took this group to Dallas.

Canadian Dealers

Except for two plane loads of Canadian dealers and guests who came to Dallas on Sunday night, Aug. 28, the remainder of the some 5,000 passengers were airlifted to Dallas on Monday from all over the U.S., arriving at Dallas between 6 a.m. and 11:20 p.m. It is estimated that 60% of the aircraft arrived within 15 min. of estimated time of arrival and some 80% within one hour of the ETA. Departure of the 5,000 passengers from the Dallas area started at 6:30 a.m. Wednesday, Aug. 31, and the last airplane left Love Field at 11:30 p.m.

Aircraft servicing was split among

TWA Idlewild Terminal Set for 1961

Trans World Airlines' new passenger terminal at Idlewild is scheduled for late 1961 completion. The four shells of the basic building are pictured before pouring of concrete and removal of wooden forms which began last month. Two fingers will extend from new building to "ramp house" gate positions at their ends. One ramp house will be located beyond the area shown at extreme upper right; its finger will connect with the terminal at the intersection of the back shell and the right shell, above. This finger is already under construction. The other finger will extend to the left from the TWA Terminal's intersection of the back shell and the left main shell, to its ramp house beyond the area pictured at upper left.

TOMORROW'S PASSENGERS WILL DEMAND GLIDERWING FLYING

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Airliners of tomorrow will fly on *clean wings* with hundreds of passengers seated in the quiet zone ahead of *rear-mounted* pure-jet engines. Here's why pilots and passengers alike will choose modern CLEAN WING FLIGHT:

- CLEAN WING, high lift efficiency and profitability opens many more airfields and routes to intercontinental jets.
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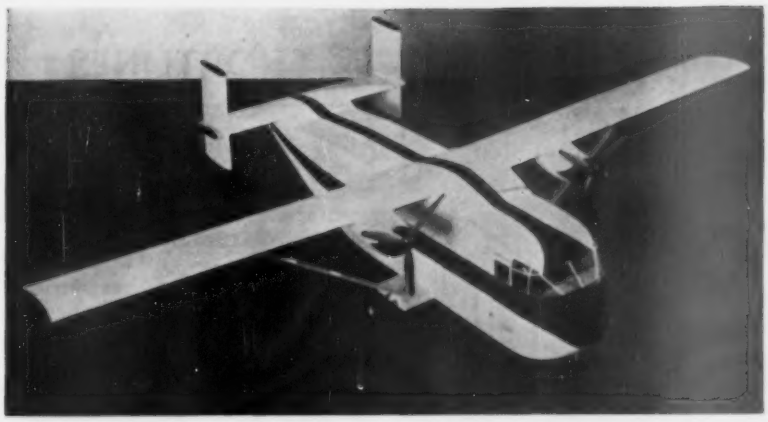


Short Bros. Designs Skyvan Transport

Short Bros. & Harland, of Belfast, will build two prototypes of the SC.7 Skyvan transport and utility plane (AW Sept. 5, p. 34), shown here in model form. Initial production batch will be 25 aircraft. Fully equipped Skyvan will cost $154,000.

the Dallas-based carriers, with American handling its own aircraft plus United and Trans-Canada, Braniff taking care of its own plus Canadian Pacific Airlines and Southwest Airmotive servicing National Airlines.

Handling the increased passenger flow into the Love terminal, which normally takes care of some 3,000 passengers daily, required setting up special control facilities within the building.

United opened a control room on the second floor of the terminal on Aug. 22, staffed by Harry Horst, UAL Dallas manager Ellsworth Perry and one girl, assisted by personnel from the carriers participating in the airlift. This control room had detailed information on every flight and was kept up to date on its progress. A "hot line" phone was connected to a reception desk on the terminal floor, where greeters awaited word on plane arrivals. As each plane landed, the control room would notify the reception desk and the greeters would meet the airplane at the specified gate, escort passengers to the terminal observation deck where they were entertained until their baggage was off-loaded and ready for pickup.

Baggage Handling

Each Deere group's baggage was identified by special tags. Scheduled plane arrivals baggage went through the conventional baggage conveyor system—bags from charter airplanes were transported to special tents set up alongside the terminal building. When baggage was ready for pickup, each Deere group was notified and escorted to the area, picked up their luggage and boarded buses waiting to take them to their hotels.

The control room went through a dry run of the operation on Aug. 25 and the staff pretended that every flight over a two-hour period represented the incoming Deere group, to ensure that the system was operational.

In New York, Pan American World Airways last week began the movement of about 5,000 appliance dealers by chartered jet from 24 U. S. cities to Hawaii for a convention and sales meeting.

One Boeing 707-320 was assigned full-time to the airlift of dealers of the Gibson Refrigerator Division, Hupp Corp.

Another 320 was phased into the peak period of the operation.

Sales Incentive

The Gibson contract marks the biggest use so far of jet aircraft in the increasingly important industrial sales incentive plans which involve air transportation (AW Dec. 14, p. 36). Revenue to Pan American from the airlift will total about $1¼ million.

The dealers were flown to Honolulu and will be returned in staggered groups, each of which will spend five days in Hawaii. Movement is scheduled so that each early-arriving group would be returned by an aircraft delivering a later group. Groups arrived at 2 p. m., and departures for the return trip were at 5 p. m. the same day. The operation is scheduled to be completed Oct. 10.

The jets were operated in a special configuration with 159-passenger capacity.

Most westbound flights had a stop at San Francisco in transit to Hawaii.

The U. S. cities involved are Detroit, Pittsburgh, Boston, New York, Baltimore, Tampa, Atlanta, Birmingham, Memphis, Louisville, Chicago, Milwaukee, Des Moines, Indianapolis, Kansas City, Dallas, Houston, San Antonio, Tulsa, Denver, Los Angeles, San Francisco, Seattle, and Columbus, Ohio.

"Expanded distribution without warehousing with Delta Air Freight"

Armour Pharmaceutical Company eliminates warehouses by airlifting area shipments to regional centers where pre-labeled and postage-paid packages are speeded to individual customers.

"Drug shipments need expensive refrigerated warehousing and special handling as a rule," comments W. F. Sheehy, Transportation Manager. "We eliminate this requirement by using Delta Air Freight and serve our customers *faster and better.* A 9-state shipment, for example, can be flown to Atlanta where individual packages, already pre-labeled and stamped, fan out to our customers in a fraction of the former time."

Profit from Delta's BIG PLUS

Delta operates all-cargo flights and in addition carries freight on every passenger flight, including Jets. All-cargo flights serve Atlanta • Chicago • Cincinnati Charlotte • Dallas • Houston • Miami New York • New Orleans • Orlando Philadelphia • Detroit • Memphis

Delta AIR LINES AIR FREIGHT DOOR-TO-DOOR

GENERAL OFFICES: ATLANTA AIRPORT, ATLANTA, GA.

AIRLINE OBSERVER

► Riddle Airlines is negotiating with General Aircraft Leasing Corp. for seven Douglas DC-7Cs now owned by Scandinavian Airlines System, with purchase hinging upon the cost of converting the aircraft to freighter configuration. Riddle is looking for a convertible interior that would permit interchangeable use of the DC-7s on Military Air Transport Service contracts and passenger charters. Airline expects to reach agreement next week on the purchase of at least three of the aircraft. General Aircraft has a fleet of 25 of the Douglas transports, 12 of them now under lease to several companies.

► **Local service carriers are pointing to West Coast Airlines as an example of what the average airline can expect from the Civil Aeronautics Board's new rate-of-return formula. Placed on final mail rates by CAB last week, the airline ended up with a 9.1% rate of return on investment, based upon a debt ratio of 77.27%. Carriers opposing the new rate formula point out that most of them were already getting a 9.5% return, but under the Board's new policy and with an average debt ratio in excess of 70%, they will find themselves with a final rate close to the CAB minimum of 9%.**

► Eastern Air Lines and Aeronaves de Mexico have signed an agreement permitting the Mexican carrier to purchase one of Eastern's Douglas DC-8 turbojet aircraft, scheduled for delivery from the factory in November. Under a new mutual jet aid pact, the airlines will share all ground facilities and services established on the New York-Mexico route served by both airlines. Eastern also will train Aeronaves flight and mechanical personnel at its training center in Miami, Fla.

► **Quebecair, Ltd., of Canada has purchased two Napier Eland-powered Canadair 540 turboprop aircraft with a 52-passenger configuration. First of the new aircraft has been put into service on an 800-mi. Montreal-Quebec City-Rimouski-Seven Islands-Wabush Lake-Shefferville route, with flag stop service to other points.**

► Pratt & Whitney estimates that its JT3 turbojet engines have now accumulated more than one million hours in airline service. First of the split-compressor turbine powerplants went into commercial airline service 22 months ago on a Pan American World Airways Boeing 707. Eight airlines currently use the JT3 on a total of 109 Boeing 707 and 720 and Douglas DC-8 transports.

► **Interline airline business settled through the International Air Transport Assn. clearing house in London registered a 31% gain during the first six months of this year, as compared with the same period last year. IATA reports the service cleared $659,864,000 in interline charges for the half year, against $449,078,000 for the first six months of 1959.**

► Soviets have extended their Mi-4 helicopter sales campaign in Norway. Mi-4 flew from Moscow to Oslo and back, covering 1,200 mi. each way, and the Russian helicopter carried about 1,000 passengers on sightseeing flights around the Norwegian capital.

► **Soviet efforts to improve air service in the Russian far east are showing concrete results. Khabarovsk, major airline hub in the area, recently got direct Tu-104 jet service to Kiev via Irkutsk, Novosibirsk and Sverdlovsk, bypassing Moscow and saving about 370 mi. There also is a new Tu-104 service from Khabarovsk to the far-northern Chukotsk Peninsula. A "200-place" hotel has been built at Khabarovsk Airport to handle sharply-increased traffic, and new airport terminals are nearing completion at Vladivostok and Petropavlovsk, Kamchatka.**

► Federal Aviation Agency is considering a change in its oxygen requirement for high altitude flights which would raise from 30,000 to 35,000 ft. the altitude above which one pilot must use oxygen equipment at all times. Other parts of the proposal would require all other flight crew members to wear quick-donning masks, with a stipulation that if this is not done, one pilot must use oxygen at altitudes of 25,000 ft. and above.

SHORTLINES

► **Civil Aeronautics Board** will hold a hearing Sept. 16 at the Del Prado Hotel in Chicago to explore the cause of the crash of a Chicago Helicopter Airways Sikorsky S-58C helicopter in July.

► **Chicago Helicopter Airways** reports that in 11 yr. of scheduled operations, it has carried over 566,777 passengers 10 million revenue passenger miles. Also, during the 11-yr. period, the carrier has flown more than 5.2 million scheduled miles and carried 26.4 million lb. of airmail.

► **Continental Airlines** still leads domestic operators of Boeing 707/720 jet transports in utilization with 11.5 hr. daily. Among the foreign airlines, Lufthansa sets the pace with 10.3 hr., followed closely by Sabena with 9.8 hr. daily utilization.

► **Eastern Air Lines** has inaugurated direct round-trip service to San Juan, Puerto Rico, from Detroit, Cleveland and Pittsburgh with Lockheed Super Constellations in tourist configuration. Eastern will operate three flights a week from the three cities to San Juan.

► **International Air Transport Assn.** has opened a new Far Eastern technical liaison office at Bangkok, Thailand, to coordinate joint technical activities of the member scheduled international air carriers serving the area.

► **National Airlines'** application to suspend service at Marianna, Fla., has been denied by the Civil Aeronautics Board on grounds that, although the city has failed to produce more than two passengers per day during the past 14 years, airlines must expect their profitable markets "in which they are protected from unlimited competition" to support unprofitable points where airline service may be needed.

► **Northwest Airlines** will retire the last of its Boeing Stratocruiser transports today. In the 11 yr. Northwest has operated the aircraft, it has carried 2.8 million passengers more than 62 million passenger miles.

► **Qantas Empire Airways** reported a net profit of $1,912,877 for 1959 to the Australian Parliament.

► **Trans-Canada Air Lines** reports that Rolls-Royce Model 506 Dart engines powering its fleet of Vickers Viscounts have reached a 3,000 hr. life between overhaul. TCA maintains 235 of the Rolls-Royce engines for its 49 Viscounts.

Can't beat Western's 707 jet service!

Lucky Los Angeles, San Francisco, Portland and Seattle/Tacoma! On Western's new 707 JET/Champagne Flights, travelers between these charmed cities are sipping private stock champagne (as well as enjoying a cocktail hour on some flights), dining on filet mignon or prime ribs, partaking in meal-sized snacks. And even budget-minded travelers are flying in style—on Western's 707 JET/Coach, with delicious hot meals that make saving a pleasure. Best of all, Western's 707's are fastest from Los Angeles to Seattle/Tacoma . . . and back.

WESTERN AIRLINES

The airline that civilized the West

Announcing the formation of AEROSPACE CORPORATION a new and vital force engaged in accelerating the advancement of space science and technology

Aerospace Corporation has been brought into being to serve the United States government by concentrating the full resources of modern science and technology on rapidly achieving those advances in space systems indispensable to the national security.

The corporation is non-profit, will share the findings of its research and laboratory experiments with all appropriate organizations involved in the government's missile-space program, and is not organized for manufacturing purposes.

The immediate responsibility of Aerospace Corporation is to aid the United States Air Force in bringing about the best possible ballistic missiles and military space systems on a continuing basis and within the shortest possible time.

In addition, it may furnish the National Aeronautics and Space Administration and other governmental agencies appropriate services whenever its participation in space exploration and related activities is desired.

THE MISSION of Aerospace Corporation, according to the Secretary of the Air Force, encompasses "the field of ballistic missile and space programs. Within this complete area, it has the responsibility for advanced systems analysis, research and experimentation, and initial systems engineering. It will also exercise such general technical supervision of ballistic systems as is appropriate. In special cases, and with the consent of the Secretary of the Air Force, Aerospace Corporation may assume broader responsibility for an Air Force military system."

The new corporation also provides support to the Air Force in its effort to achieve maximum interchange of knowledge with other military services and among universities, research foundations, and the scientific community in general.

THE FUNCTIONS of Aerospace Corporation in carrying out its responsibilities for the Air Force's missile-space programs include the performance of a wide range of scientific, technical, and administrative tasks.

The corporation will conduct extensive laboratory and field activities aimed at advancing the state-of-the-art and will augment these research and development activities by coordination with industry, universities, laboratories, and other agencies. It is intended that this combined effort will push forward the boundaries of technology on a broad front to fulfill military and other national requirements.

Aerospace Corporation will study the application of the advancing technology to military weapons, support systems, and other systems serving the national need. These studies will culminate in preliminary design and in recommendations for development programs.

Aerospace Corporation will then assist the Air Force or other appropriate government agencies in establishing space programs and in bringing the force of American industry to bear in carrying them out. Once development is initiated, Aerospace Corporation will assume responsibilities for the broad technical aspects of these new programs through their critical phases.

THE FACILITIES of Aerospace Corporation include a research and development center located near the Los Angeles International Airport and within easy reach of several attractive residential communities.

They constitute a modern administrative, scientific, and engineering headquarters which house some of the world's most advanced instrumentation and experimental apparatus.

In addition, the operations of Aerospace Corporation will be directly supported around the globe by a vast array of resources created by the government over the past six years. These will include: The Atlantic Missile Range in Florida; The Pacific Missile Range in California; The Rocket Engine Test Site at Edwards Air Force Base in California; and numerous other missile test facilities sponsored by the government in cooperation with private industry.

THE PEOPLE who make up Aerospace Corporation have been selected from industry, universities, and government. They constitute a cross-section of highly-developed engineering and scientific skills in the missile and space fields.

Extensive recruiting will continue as the new corporation assumes more and more responsibility. From the outset, the corporation is built on a foundation of proven scientific competence, imagination, and objectivity.

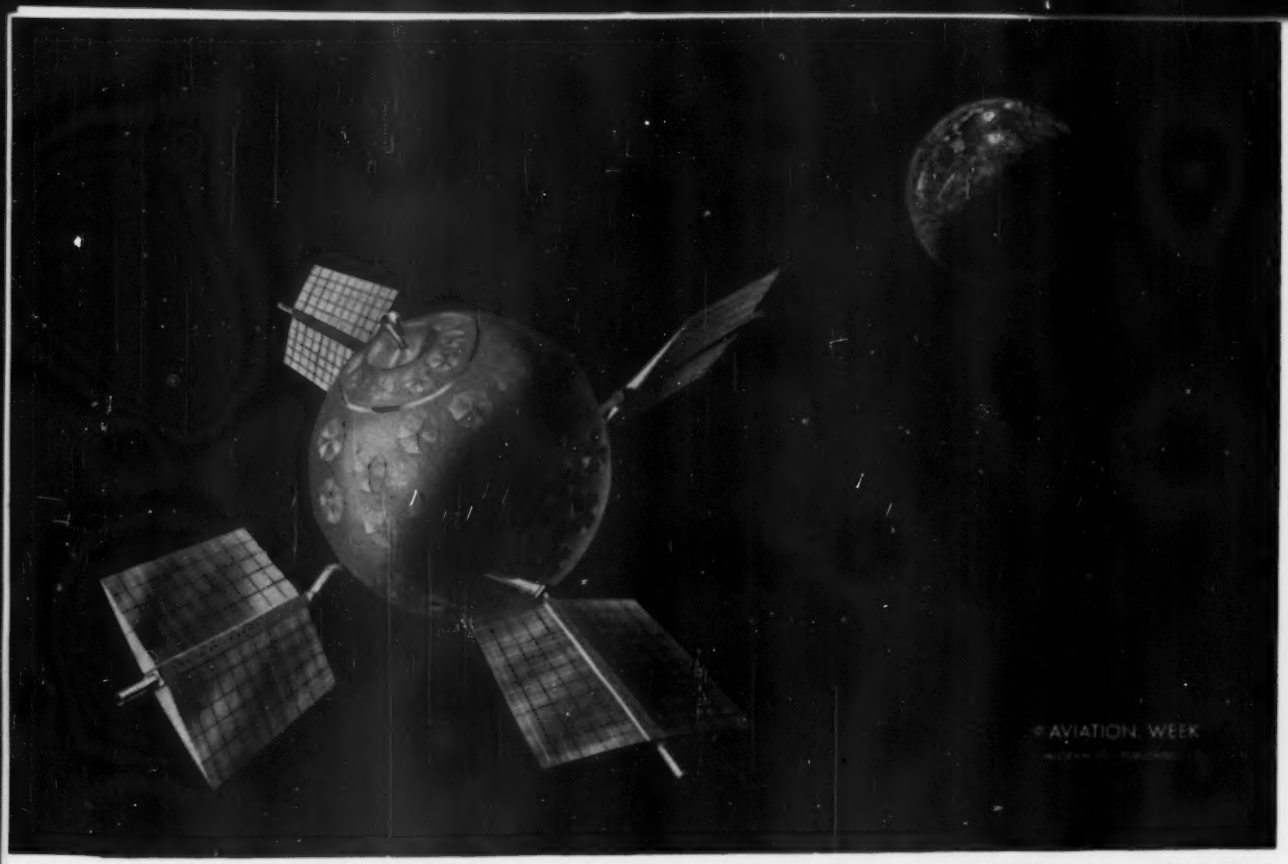
THE OPPORTUNITY awaiting those scientists and engineers who qualify to join Aerospace Corporation is equalled only by the magnitude of the corporation's mission – magnitude mirrored by the highly advanced nature of the programs in which Aerospace Corporation is engaged.

Typical systems projects include: advanced ballistic missiles; advanced military space boosters; recoverable boosters and satellites; space defense systems; early-warning satellites; reconnaissance satellites; communications satellites; and manned satellite systems.

Typical research programs concern: nuclear propulsion; astrodynamics; magnetohydrodynamics; inertial elements; millimeter waves; hypersonics; combustion kinetics; and materials research.

Those capable of contributing to state-of-the-art advances in these and related areas are invited to consider the advantages of becoming a part of the new Aerospace Corporation. Their resumes should be directed to: Mr. James M. Benning, P. O. Box 95081-C, Los Angeles 45, California.

AEROSPACE CORPORATION 2400 East El Segundo Boulevard • El Segundo, California



PIONEER VI lunar orbiter is programed to course around the moon in a tight path with approximately 5,700 lunar apogee and a 3,800 mi. lunar perigee, and a period of about 16 hr. Satellite will be 39 in. in diameter, with nozzles extending 8 in., at opposite ends of the spin axis, from the internal, multiple-start propulsion system used for trajectory midcourse correction and for injection of the satellite into orbit.

Pioneer VI Designed for Moon Orbit

Washington—New target in the stepped-up U. S. space program will be the injection of a 388-lb. instrument-packed Pioneer VI payload into a tight, near-circular orbit around the moon. Launch vehicle—the three-stage Atlas Able V—is programed to fire the payload from Cape Canaveral, Fla., on Sept. 22.

It's a more ambitious and scientifically exacting program than the Soviet's Lunik III experiment (AW Oct. 12, 1959, p. 103), which put a camera-carrying satellite into a long, sweeping closed-loop path around the earth and the moon.

At the end of an approximate 240,000-mi. hyperbolic-approach transfer trajectory, Pioneer VI will be radio-commanded from the ground, probably from Manchester, England, Singapore or Hawaii, to fire its 20-lb.-thrust, monopropellant, multi-start propulsion system to orbit the moon with a payload path having a lunar apogee slightly more than 2½ times the lunar diameter (2,160 mi.) or about 5,700 mi. above the lunar surface, and a lunar perigee of about 3,800 mi.

The lunar experiment will include these highlights:

• **Approach to the lunar orbit** will be along the path of a hyperbola.

• **Approach velocity to the moon** will be approximately 2,900 mph.

• **Payload's hydrazine** monopropellant propulsion system, which will be used for trajectory adjustment before reaching the vicinity of the moon and also to slow the payload as it approaches the moon to assist the weak lunar gravitational field to hold it in a tight path, will be capable of making six starts—four to increase the velocity increment and two to decrease the velocity increment. Five of these starts probably will be used to correct the trajectory before reaching the moon's vicinity, while one of the starts will be used to inject the payload into orbit around the moon. The payload engine's retrothrust will be capable of imparting a velocity increment of about minus 2,000 mph.

• **Payload will pass under** the moon to the injection point, which will be reached approximately 60½ hr. after launch vehicle burnout, then will course upward into its lunar orbital path.

• **Period of lunar orbit** will be approximately 16 hr. In this orbital plane, practically a polar orbit, the payload will be receiving direct sunlight.

• **No camera will be carried** in Atlas Able V's Pioneer VI payload, even though the scanning system had been programed for the Atlas Able IV experiment, the previous unsuccessful lunar orbit attempt (AW Dec. 7, 1959, p. 52). The system had been used in Explorer VI earth orbiter with 24,618-mi. apogee and 115-mi. perigee (AW Aug. 17, 1959, p. 30), but pictures returned probably lacked desired defini-

Lunar Orbit Participants

Major participants for Atlas Able V and Pioneer VI project are:

• **National Aeronautics and Space Administration, which has cognizance of the project.**

• **Air Force Ballistic Missile Division, under whose cognizance the Convair Atlas first stage was developed. Air Force also is operating the Missile Test Center's Cape Canaveral launch site and the associated Space Navigation (SPAN) Center.**

• **Space Technology Laboratories, which has systems engineering and technical direction responsibility for the Atlas Able V vehicle, major responsibility for the design and development of the Pioneer VI payload, and also is supplying crews for various tracking facilities.**

tion. Another factor probably is the existence of the photos obtained with Lunik III.

The trajectory to, and around, the moon will encompass a wide range of test objectives. In addition to the attainment of the tight lunar orbit, an analysis of data on environmental conditions in space and specifically the vicinity of the moon, and performance of the launch vehicle, its staging, transfer trajectory control, and midcourse guidance, will afford a valuable fundamental knowledge for refinement of future space vehicles.

Instrumentation in the Pioneer VI payload will gather data during the transfer trajectory and in the vicinity of the moon. Instrumentation and experiments include:

• **Plasma probe.** This National Aeronautics and Space Administration-Ames Acronautical Laboratory experiment will provide data on the lunar environment relative to proton streams having proton energies in excess of a few kilovolts per particle.

• **Cosmic ray scope.** This is a University of Chicago experiment to provide information on integrated intensity of moderately energetic cosmic ray particles in the lunar environment. Particle identification will encompass those with minimum energy levels exceeding 12 MEV for electrons and a value of 70 MEV for protons. Information gathered is expected to resolve the knowledge gap in the determination of whether the results may be attributed to changes in earth environment or a process extending into the core of the solar system. Information on particles stemming from solar flares also will be obtained.

• **Ion chamber and Geiger-Muller tube.** This is a University of Minnesota experiment related to flux and counting rate of particles with energy values exceeding 1.25 MEV for electrons, and proton values exceeding 25 MEV. Results are expected to provide data on ionization of particles in cosmic ray flux and solar flares encountered in the lunar environment. Data will be compared with information obtained with instrumentation in an earth-balloon experiment, conducted while the Pioneer VI payload is gathering data in the lunar environment.

• **Flux gate magnetometer.** This is a Space Technology Laboratories experiment which will measure low-frequency magnetic field changes in space. Magnetic fields parallel to the spin axis of the payload will be measured.

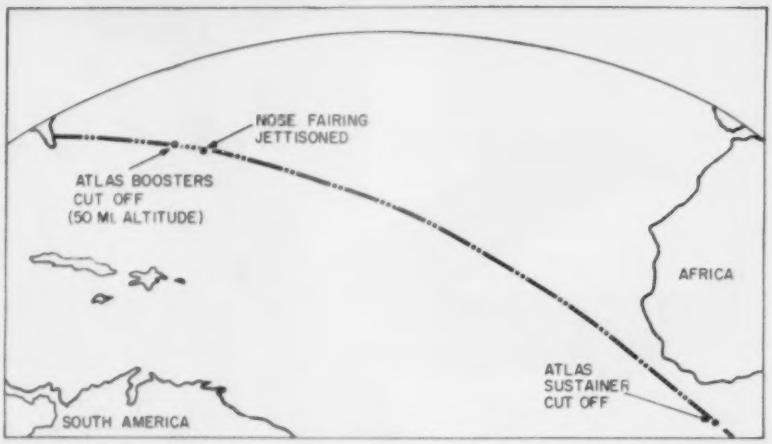
• **Spin search coil magnetometer** and phase comparator. This STL experiment will provide data on the magnetic field perpendicular to the spin axis of the payload. The phase comparator and associated equipment will provide angular values between the perpendicular component and the projection on the payload equatorial plane of the sun-payload line. In addition, magnetic fields in the lunar environment will be measured, and data gathered on low-frequency field variations during the transfer trajectory.

• **Scintillation spectrometer.** This is an NASA/STL experiment to measure protons with energy levels not exceeding 20 MEV per particle both in the lunar environment and in the radiation belt encountered in the transfer trajectory.

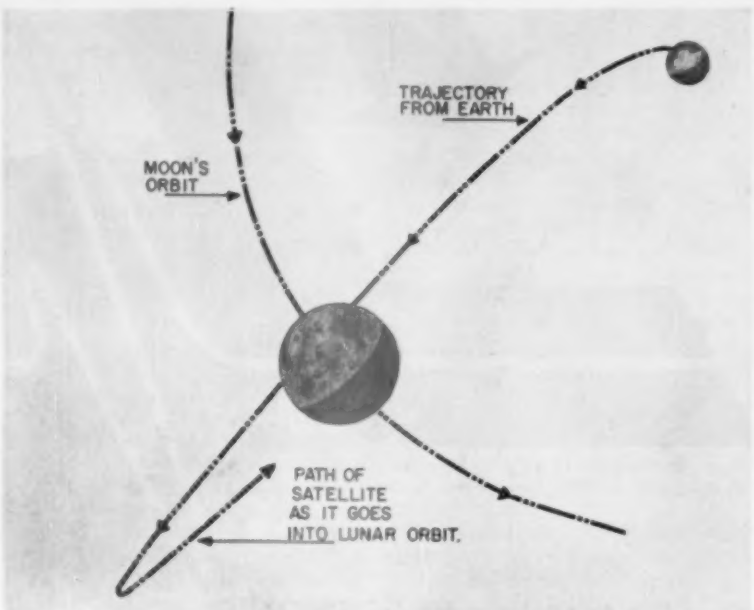
• **Low-energy scintillation counter.** This STL experiment will count electrons with low energy and protons with higher energy along the transfer trajectory. Total flux will be determined for electrons exceeding 50 KEV, and for protons with energy levels exceeding 450 KEV.

• **Micrometeorite flux and momentum.** This is an NASA/STL experiment to determine the number of impacts with micrometeorites and dust particles with momentum related to specific reference values. Information obtained will be analyzed in relation to meteor showers in the earth's environment.

Atlas Able V launch vehicle's liftoff weight will be about 265,000 lb. It will include the Air Force Ballistic Missile



THREE-STAGE Atlas Able V for boosting Pioneer VI lunar orbiter into its transfer trajectory will be launched from Cape Canaveral, Fla., at an azimuth heading of about 93 deg., taking it high across the Atlantic Ocean, past the African west coast.



AFTER approximately 240,000 mi. transfer trajectory and 60½ hr. after Atlas Able V boost vehicle's third stage burnout, the Pioneer VI payload will be injected into orbit around the moon, with assist from its self-contained propulsion system.

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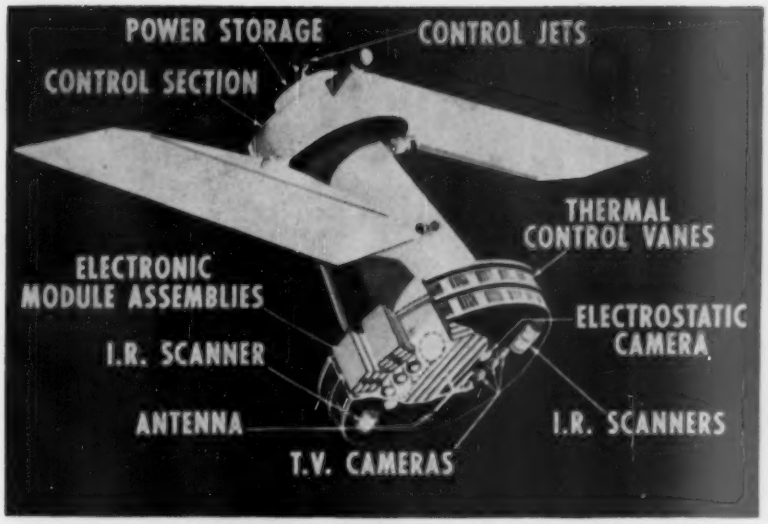


Nimbus Weather Satellite

Nimbus second-generation weather satellite (AW Sept. 5, p. 26) is designed for 600-mi. polar orbit and continuous television portrayal of cloud cover for six months. The 650-lb. vehicle will be boosted into orbit by Thor Agena launch vehicle on a schedule beginning late next year, after two more Tiros weather satellites are launched. Large paddles will house solar cell arrays, capable of generating 200 watts per orbit. Nickel cadmium batteries will store excess power.

Division's Convair Atlas as primary booster, developing a total thrust exceeding 365,000 lb. Second stage will be the Aerojet-General AJ10-101A, developing approximately 7,790 lb. thrust using inhibited white fuming nitric acid and unsymmetrical dimethylhydrazine. Third stage is the Allegany Ballistic Laboratory's X248-A9 solid propellant rocket engine developing 3,115 lb. thrust.

Ten small Atlantic Research Corp. rockets will be used to spin the payload.

Payload's propulsion system, weighing about 58 lb. dry, uses approximately 135 lb. of hydrazine as a monopropellant with aluminum oxide as the ignition catalyst. Two 8-in.-long nozzles will protrude at opposite ends of the spin axis from the 39-in.-diameter payload for an over-all diameter of 55 in.

Four lines extend from the hydrazine tank to the aft nozzle and two lines extend to the forward engine nozzle. Each line contains "open" and "close" valving and can be used only once, thus giving the engine the capability of six starts.

Nitrogen-pressurized tank holding the hydrazine is located in the center of the payload, complemented by two smaller adjacent nitrogen tanks to increase pressurization during injection rocket firing.

Ground station command will open the "close" valving to permit hydrazine flow to the thrust chamber. A second command will close the "open" valving, shutting off the flow. This operation is repeated for another start, using a different line. Duration of the hydrazine flow determines the increase or decrease of the velocity increment for the payload, depending upon which nozzle is used. Payload propulsion thrust is approximately 20 lb.

Atlas Able V vehicle will be launched from Cape Canaveral at an azimuth heading of approximately 93 deg. This will take the vehicle across the Atlantic, past the tip of Liberia in Africa just before burnout of the Atlas booster sustainer engine.

In the flight sequence, approximately 140 sec. after launch, the Atlas booster barrels will burn out. At this point the vehicle will be about 50 mi. high. About 20 sec. later, the 10-ft.-long, two-piece glass fiber nose fairing is jettisoned from its attachment at the top of the second stage, thus uncovering both the third stage and the satellite payload.

Sustainer Barrel

The Atlas sustainer barrel continues to burn for about 2½ min. after the booster barrels have been cut off. Second stage ignites almost immediately thereafter and burns for just under 2 min. Solid propellant third stage is fired almost immediately after second stage burnout and burns for a period well under a minute.

The hydrazine system in the payload will be radio-commanded from the ground to provide trajectory correction during the midcourse phase, with the first correction input triggered within 60 sec. after the third stage burns out, to ensure proper transfer path. Capability exists for four more trajectory corrections with the payload propulsion system, plus another start (retrothrust) for injection of payload into its lunar orbit.

Temperature control for Pioneer VI satellite will be maintained with stubby, four-bladed "propellers" which were first evaluated on Explorer VI elliptical earth-orbit satellite and later incorporated in the payload of Atlas Able IV which failed when the nose fairing was jettisoned prematurely.

The propeller blades are controlled by preset high and low-temperature levels. Small patches of dark material are attached to the satellite's spun aluminum shell to conform to the stubby propeller blade configuration. Beneath the patches are wire coils which expand on heating and contract when cooled. When the dark patches are exposed, solar heat is absorbed to raise the temperature in the instrument compartments.

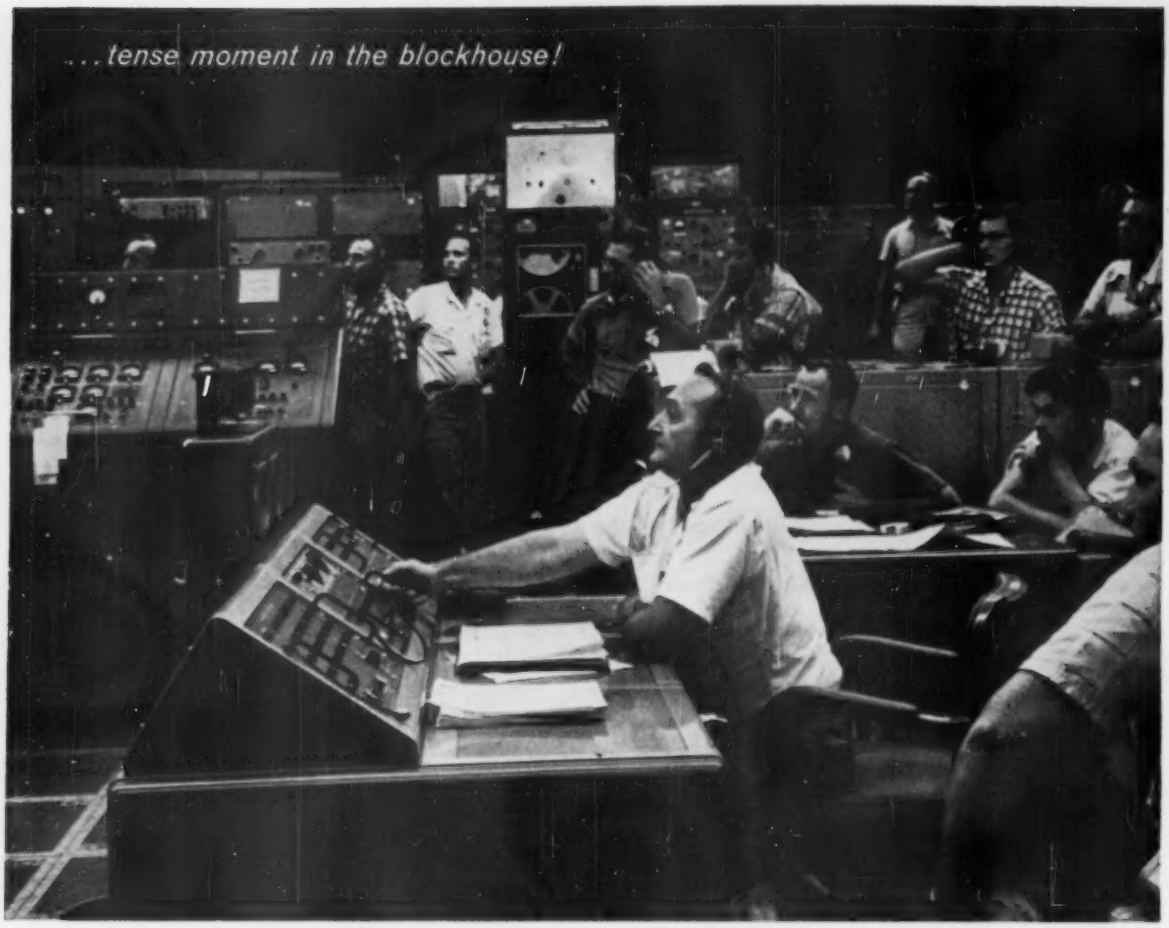
When the preset high-temperature level is reached, the coils expand and rotate the propellers until their heat-reflecting surfaces cover the dark patches, thus dropping the temperature gradually through heat-sinks within the instrument compartments. When the temperature drops to the preset low level, the coils contract and the propellers rotate to expose the heat-absorbing dark patches to raise the temperature within the payload.

Four solar-cell paddles for charging nickel-cadmium batteries continuously extend on arms, just before third-stage ignition, from the equatorial plane of Pioneer VI, within an envelope diameter of 108 in. Each surface of a paddle is decked with 1,100 solar cells, for a four-paddle total of 8,800 cells.

Four aluminum dipole rods (antennas) for the two transmitters (378.2 mc.) and two receivers extend from the payload.

The global network of tracking stations are Air Force Missile Test Center, Massachusetts Institute of Technology's Millstone Station, Jet Propulsion Laboratory's Goldstone, Calif., site, Manchester, Singapore, and South Point, Hawaii.

Flight path measurements will be received at Ballistic Missile Division-Space Technology Laboratories Space Navigation Center at AFMTC for processing. This information will be relayed to the counterpart center in Inglewood, Calif., for computer calculations for trajectory prediction for transmission to the various ground tracking stations. This trajectory prediction will be based on trajectory conditions during and immediately after burnout of the Atlas Able V vehicle. Trajectory correction will be accomplished by firing the payload's hydrazine engine by command from guidance station at the Missile Test Center.



Kinetics Voltage Sensing Relay helps test conductor get the answer "All systems GO!"

The Kinetics Voltage Sensing Relay with all-solid-state voltage sensing circuit.

In operational command control centers for launching the Atlas missile, Kinetics Voltage Sensing Relays provide vital "go – no go" information to the test conductor. The voltage sensing circuit is a completely solid-state device that can provide continuous monitoring of any a-c or d-c missile voltage

Typical voltages to be monitored are telemetering signal levels, inverter outputs, batteries, and similar important voltages. Relays may be supplied that will trip only on low voltage or on low and high voltage, with both "set" and "reset" actions, as desired. Output from the 2-pole, double-throw relay contacts may be used to start small motors, blow horns, operate lights or larger relays

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The Kinetics Voltage Sensing Relay is ideal for missile launching ground support equipment. However, it is also small, lightweight and rugged enough for airborne applications. Write or phone today for more information. Kinetics Corporation, Dept. KA-9, 410 South Cedros Avenue, Solana Beach, Calif. SKyline 5-1181

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Douglas Designs Delta Flight Controller

By Russell Hawkes

Santa Monica, Calif.—Flight controller specially designed to give NASA Delta space vehicles precise orbits and trajectories, such as that of Echo I, first Delta payload, was created by prime contractor Douglas Aircraft Co. in seven months from start to delivery of the first hardware.

For the Delta flight controller, NASA sought high precision at low cost and low weight. Cost was not announced but weight was held to 42 lb. The four units in the controller are concentrated in the front end of the second stage and wiring between them probably adds less than 6 lb. to the total weight of the system.

Contributing to precision of flight is attitude control during the coasting phase of second stage flight, a feature which Douglas engineers regard as unique. The controller is designed to stabilize the last two stages within 0.3 deg. of nominal attitudes in pitch and yaw and within 3.0 deg. in the roll plane.

Attitude Corrections

Earlier Thor-boosted space vehicles had no flight control operating during the coasting phase. This meant that all attitude corrections had to be made during the powered phase of flight with some penalties to performance and with the possibility of a negligible undamped error rate at the beginning of the coast phase developing into a significant effort by the end of it. Attitude control to the end of the coast phase is insurance against this.

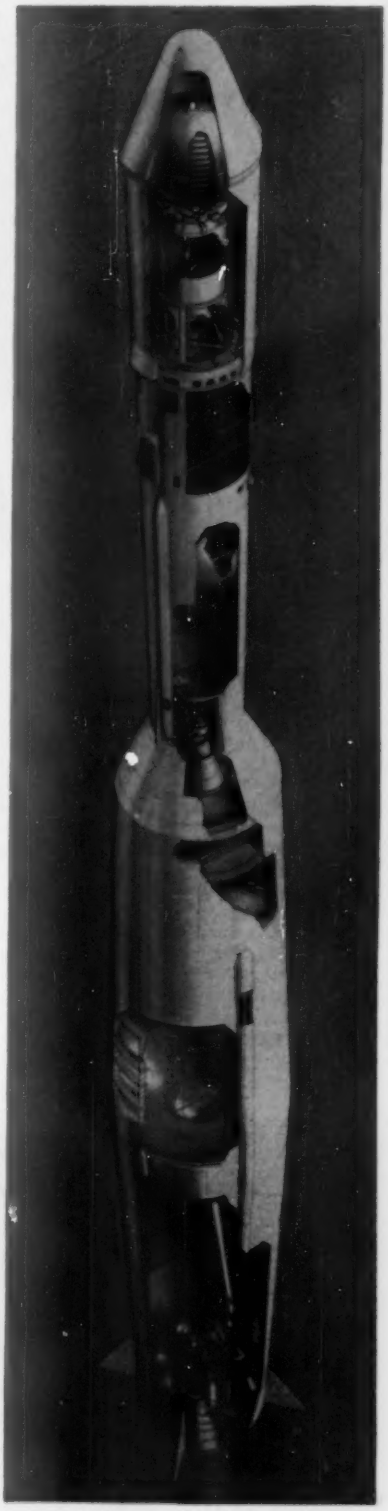
NASA specified that in the Echo launch Delta should be able to place the payload in a 900 naut. mi. circular orbit. The tolerance in circularity of the orbit was 100 naut. mi. plus or minus the mean altitude. The actual orbit was well within this range, having an apogee of 917 naut. mi. and a perigee of 822 naut. mi.

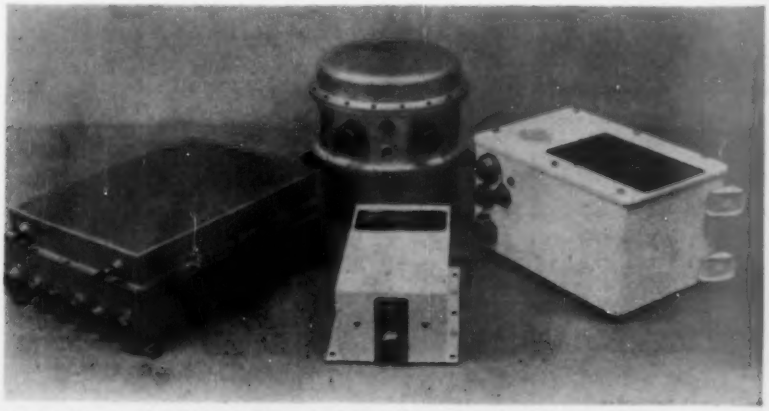
A flexible selection of programs was one of the chief requirements voiced by NASA and is now one of the chief claims by Douglas. The Delta system is slated for a variety of mission trajectories including a lunar probe, earth orbits of varying ellipticity, and orbits close to a north-south plane which will have to be launched in a dog-leg to the right to get safely around the eastern corner of Brazil.

Program Choices

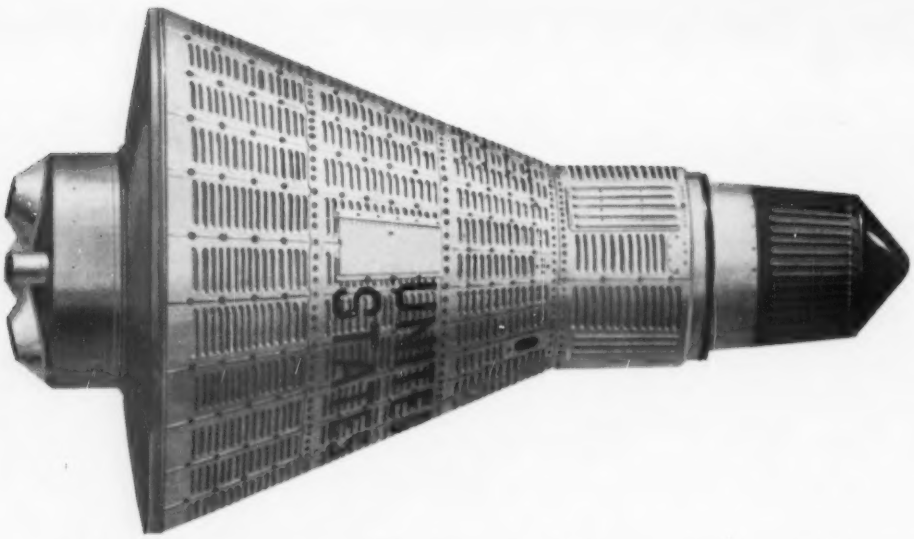
Because of its program flexibility, the Delta controller cannot be regarded as equivalent to a tactical unit. The freedom of choice in picking a program makes the job longer and more complicated than the military could accept. However, if an alternate mission has been planned several weeks in advance, it is a matter of hours to replace the six printed circuit module boards in the shaping net. The points in time at which the programer is to command the occurrence of different events are selected by choosing the appropriate screw contact switches in a solid state diode matrix. Events are sequenced on 16 channels. When these events are attitude changes, a panel of 10 permanent resistors can be switched in or out of the circuit in any of 1,060 different combinations, producing an equal number of overlapping gyro torque level bands. A single variable resistor can be adjusted to give a precise point within each band. Each band of gyro torquing levels is about .25 deg./sec. wide.

It was the flight controller which





FOUR UNITS in the Delta flight controller are the programer, left, gyro unit, center rear, power supply, foreground and electronics package. Units are grouped below spin stabilizer at top of the Delta space vehicle. Cutway also shows Echo payload sphere.



CUBIC AGAVE CHOSEN FOR PROJECT MERCURY TRACKING!

Cubic Corporation has been selected by Bendix Corporation to furnish AGAVE automatic tracking antenna systems for the National Aeronautics & Space Administration's world-wide Project Mercury tracking and ground instrumentation network. These units will detect the manned capsule as it first comes over the horizon, lock on, and subsequently supply pointing information to radars, telemetry antennas and command transmitters.

While precision radars achieve high accuracy and long-range operation by using narrow beamwidths, these same narrow beamwidths inherently create serious problems of (1) initial target acquisition and (2) reacquisition if the target is subsequently lost. AGAVE combines a broad 20° beamwidth with adequate pointing accuracy to orient narrow-beam tracking devices. Continuous-wave correlation detection and the 18-db gain of the antenna array permit reliable tracking over a 1000-mile range with only a ¼-watt telemetry source in the target.

OTHER USES: AGAVE can also serve as a self-tracking telemetry antenna. The front-end passes the entire 215 to 265 mc telemetry band. One AGAVE provides angle-only information for range safety—two AGAVEs provide complete position data. AGAVE forms the basis of an ideal manual or fully-automatic drone guidance system.

For more information on AGAVE, please write to Dept. AW-3, Cubic Corporation, San Diego 11, Calif.

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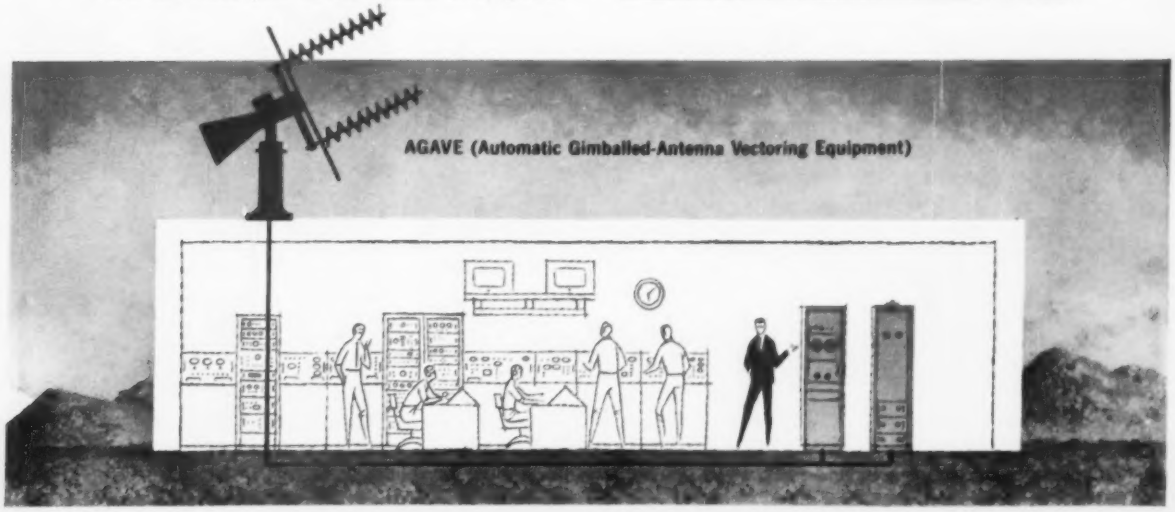

AGAVE (Automatic Gimballed-Antenna Vectoring Equipment)

failed during the first attempt to launch an Echo satellite. Apparently it ceased to operate about 740 sec. after launch at an altitude of about 600 mi. The last two stages coasted to the nominal altitude of 900 mi. and the final stage fired, but Douglas engineers estimate that because of attitude control loss it was launched downward and away from the planned orbit.

After determining that control had been lost on all three axes of rotation, Douglas engineers concluded that the loss had been caused by a random failure of an unknown component in the 20 v.d.c. power supply. Some engineers have theories about which component failed, but there is little agreement. Lacking any firm knowledge, Douglas refined the design of the power supply for greater reliability and tested it intensively. It was the refined model which put Echo I into orbit.

Miniature integrating gyros made by Minneapolis-Honeywell or Kearfott Division, General Precision, Inc., are the heart of the Douglas flight controller. They are similar to those used in NASA's Scout vehicle, but are installed in a lighter unit required by Douglas specification. The gyros turn on ball bearings and the gimbals are floated in a fluoride compound held within a quarter of a degree of 180F to make its density equal to the average density of the gimbal cage. The purpose of this is to give the gyro neutral buoyancy and reduce friction. Douglas managed to avoid using rate gyros by differentiating position information.

The Douglas-built flight controller acts through helium reaction control jets. The helium is stored at about 2,000 psi. and ported to the nozzles at about 40 psi. The two pairs of roll jets at the front end of Stage 2 operate during the burning time of the main propulsion as well as during the coasting phase. Pitch and yaw jets are at the aft end of Stage 2 and are buried in the interstage structure until the Thor booster backs away at stage separation.

Earlier Thor-boosted space vehicles had only the standard military autopilot flight controller with a fairly high drift rate, which was acceptable because of the presence of a guidance system. In six of the Thor-Able shots, the military autopilot was used alone with the military guidance system removed. The Delta system was intended to be lighter and more accurate than either of these arrangements. The Bell Telephone Laboratories radio-inertial guidance system of Delta weighs only 150 lb., while the tactical guidance system is reported to weigh a half ton.

The Delta programer can control the timing of a sequence of events with an error no greater than 0.01%. After 2,000 sec. of flight this amounts to 0.2 sec.

Resistors in the Delta programer cannot be allowed to change value because of temperature changes, therefore an oven in the programer holds temperature constant in flight.

Guidance System Operation

In Delta, the BTL guidance system functions through the tactical autopilot and control system of Thor until stage separation 160 sec. after launch. Thrust termination on Stage 2 is programed on the basis of speed rather than time, which cannot be forecast with such precision. However, the coasting phase is timed with great accuracy. Since the duration of Stage 2 burning is not known in advance, the programer is shut down at ignition and restarted at thrust termination.

When the flight controller has established the vehicle in the proper attitude during the coasting phase, six small solid propellant rockets start the spin table on which Stage 3 is mounted. At about 1,175 sec. after launch, the spin stabilized final stage is fired and at about 1,215 sec. the payload is ejected and four small rockets tumble the burned out Stage 3 motor to keep it from colliding with the payload. The maximum operating time of the programer is 2,047.5 sec. which Douglas reports should be adequate for any Delta mission.

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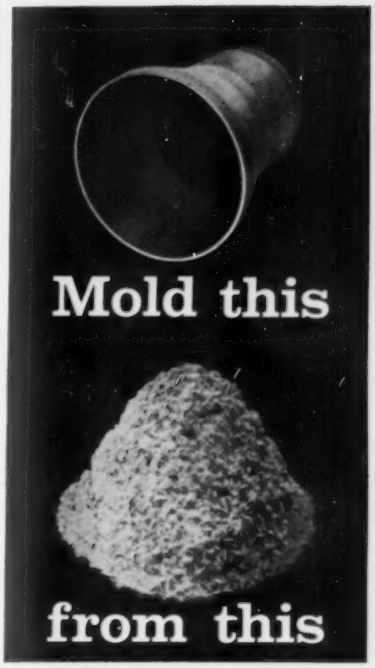

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Virtually every U.S. missile carries plastic parts made of R/M raw materials. Starting point for many of these parts exposed to burning propellants and other high-temperature environments is R/M Style 150RPD molding compound.

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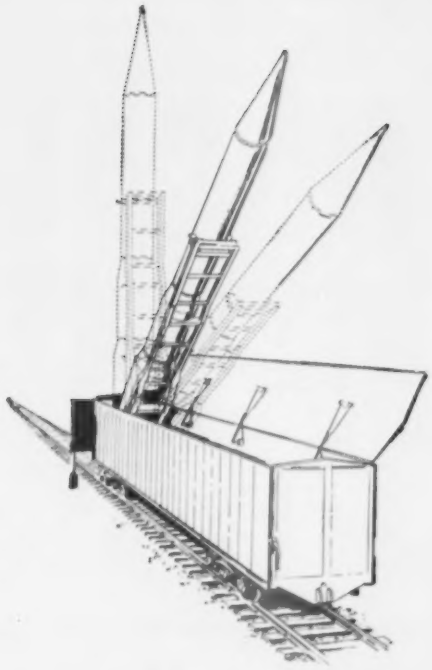

ACF's CHECK LIST FOR DEFENSE PROCUREMENT

☑ **engineering:** American Car and Foundry's engineering staff is trained to design from rough plans, develop the product to meet performance standards and create the processing equipment which will achieve the most efficient production.

☑ **manufacturing:** Five huge plants offer advanced facilities for tooling, heat treating and fabricating both ferrous and nonferrous metals and modern alloys.

☑ **research & development:** From initial drawing to prototype, through pilot or full plant production—sound, modern, workable products.

☑ **quality control:** Every phase of the manufacturing process is inspected by up-to-the-minute equipment and techniques to insure highest standards of quality and performance.

☑ **experience:** Ammunition • Armored vehicles • Propulsion system components • Ground Support equipment • Transportation equipment • Communications hardware • Research and development

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TAPCO ELECTRICAL POWER COMPONENTS

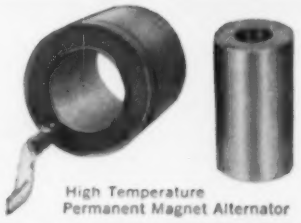
TAPCO Group primary and auxiliary electrical power systems for space, missile, aircraft and ground power applications are tried and proven. Systems performed under environmental conditions including nuclear radiation, high-temperature, liquid metal vapor, zero-G and vacuum.

Below are typical TAPCO components now available for integration into systems for such applications. Other available TAPCO electrical power components include tachometer generators, speed sensors, high temperature electromagnets and solenoids, nuclear reactor rod drive controls, static inverters, voltage regulators and electronic power conversion devices.

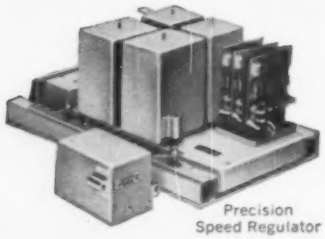
ALTERNATORS

Among the special purpose rotating machines designed by TAPCO is a series of high temperature alternators. These range in capacity from a few watts to 15 kw at temperatures up to 1000°F.

PERFORMANCE DATA: TYPICAL ALTERNATOR—**Power Rating:** 3 kw, 0.8 pf lagging. **Ambient Temp.:** 700°F. max. **Operating Speed:** 40,000 rpm. **Output:** 115v, 2000 cps. **Inherent Voltage Regulation:** ±5%. **Harmonic Content:** 5% total. **Efficiency:** 85%. **Weight:** 9 lbs w/o shaft and bearings. **Size:** 3⅜" OD, 5⅛" long. **Special Conditions:** Operates in mercury vapor.



High Temperature
Permanent Magnet Alternator



Precision
Speed Regulator

VOLTAGE REGULATION AND SPEED CONTROLS

Associated with the TAPCO alternator and drive systems are system speed and voltage controls for extremely accurate frequency and voltage regulation. The unit shown is adaptable to many drive systems.

PERFORMANCE DATA: TYPICAL SPEED REGULATOR: **Frequency Stability:** 1 part in 100,000 integrated over minimum 1 hour period. **Input:** 115v, 400 cps. **Output:** 0-10v, 400 cps (phase reversing). **Feedback:** Valve position 0-57.5v, 400 cps. **Environmental Conditions:** −65 to +200°F, 50g shock for 11 millisec., vibration 0.1" double amplitude from 3 to 23 cps, 10g from 23 cps to 10 kc. **Weight:** 10 lbs. **Size:** 12" x 6" x 5".

LIQUID METAL PUMPS

A rotating permanent magnet driven by an external source induces pumping force in the liquid metal within a hermetically sealed system. This concept provides operation without friction-producing rotating seals and provides exceptional reliability and life.

PERFORMANCE DATA: TYPICAL ELECTROMAGNETIC PUMP—**Fluid:** Sodium. **Fluid Temperature:** 1000°F. **Capacity:** 20 lbs/min. **Driving Speed:** 40,000 rpm. **Pressure Rise:** 3 psi. **Weight:** 3 lbs. **Size:** 2¾" diam. flange bolt circle, ½" nominal pipe size.

Electromagnetic Sodium Pump

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Ames Builds Flight Simulator Centrifuge

Moffett Field, Calif.—An unusual flight simulator centrifuge is under construction by NASA's Ames Research Center here to make possible laboratory experiments in flight control involving 5 deg. of freedom of motion.

The centrifuge will whirl a 25-ft. high tower around a circular railroad track with a diameter of 45 ft. On the tower is a high speed elevator carrying a three-degree-of-freedom gimbal cage within which is an airplane cockpit section. The total weight of moving parts is 24,000 lb.

The simulator will be used to investigate the competence of a human pilot to control the flight of aircraft and space vehicles when subjected to different accelerations and decelerations. Early attention will be given to problems of control during re-entry.

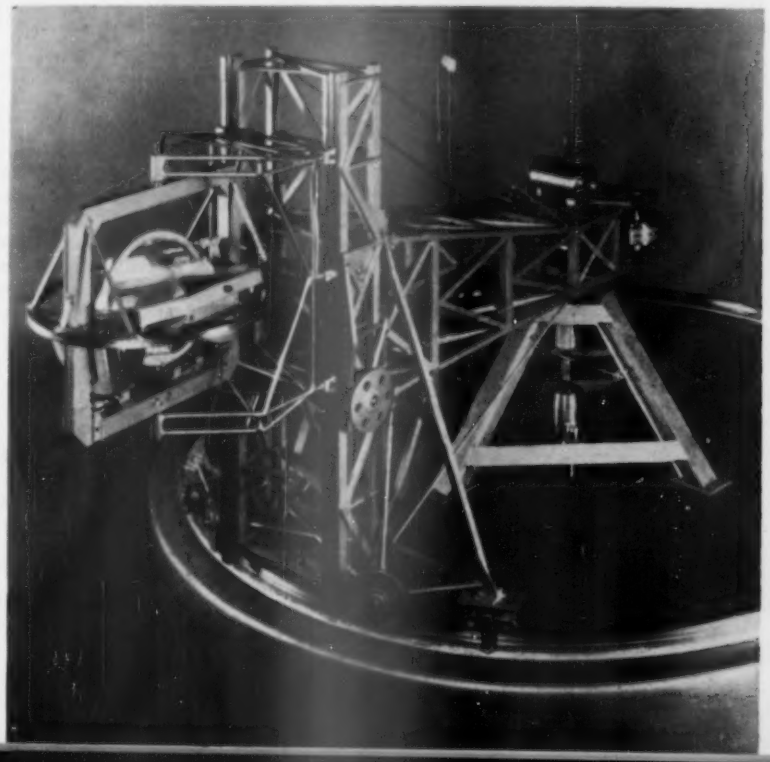
Tests of the complete simulator are to begin in October and its designers estimate it will begin yielding data by the first of the year. The gimbal cage and cockpit section have already been finished and are being checked out separately. The NASA designers think the checkout will be complete by the time the centrifuge is ready to be tested. If it is done earlier, it will probably be used by itself in experiments needing only the three rotational degrees of motion.

The simulator is being built under a stringent economy budget with scavenged parts in many key places. Total budget is $215,000 plus an undetermined number of man-hours by permanent NASA employes.

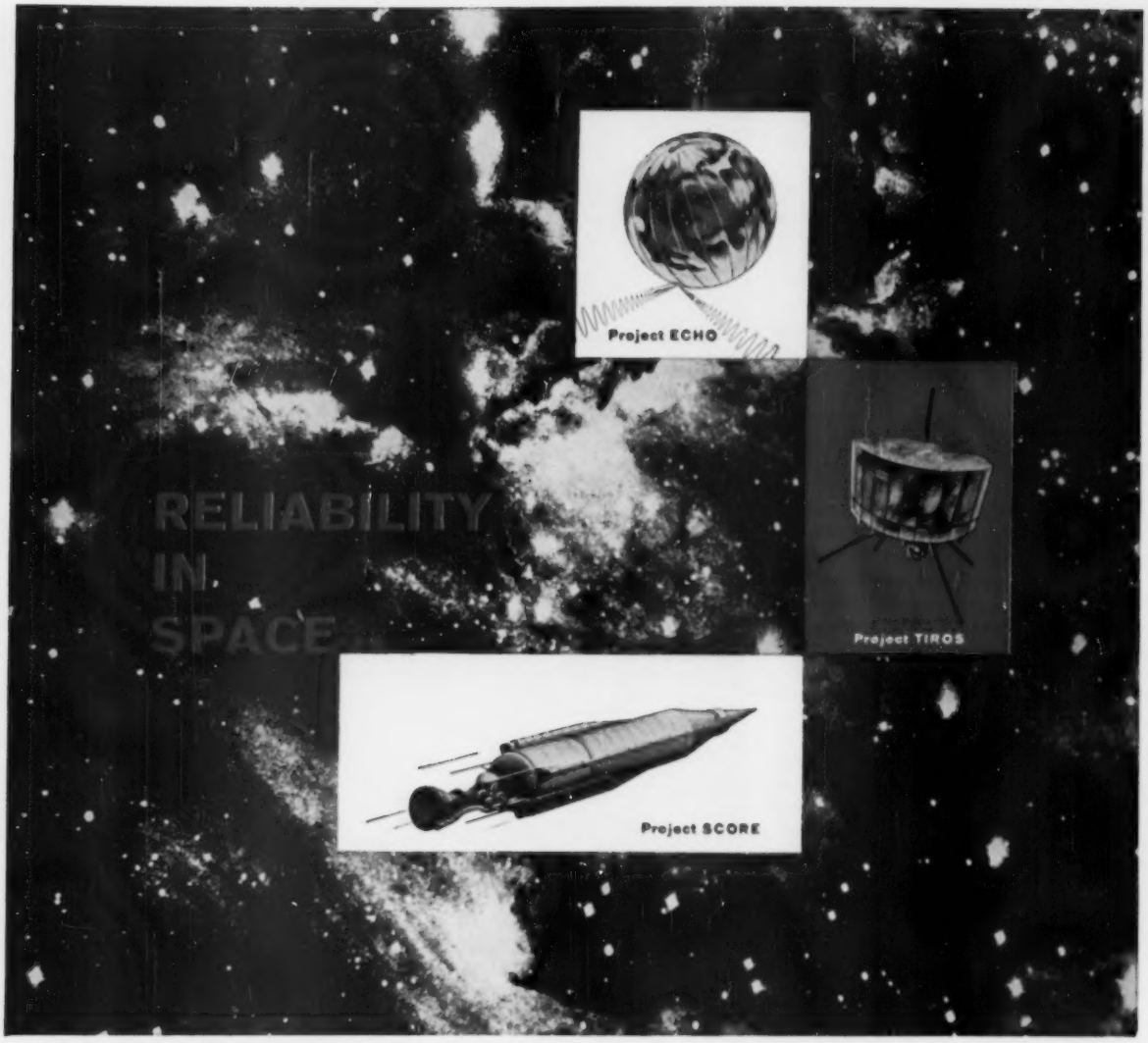
The 6g radial force which the Ames centrifuge will be able to produce is very slight compared with the 40g of Navy's Johnsville, Pa., centrifuge, but the multiple movements of the Ames centrifuge make possible a potentially dangerous accumulation of accelerations. If a pilot subjected to 6g were to roll the cockpit into an inverted position and slam the elevator against its bottom stop, the force components might add up to a fatal result. The simulator had to be designed to prevent this without compromising the simulation of flight.

A 74 to 1 reduction ratio gear box capable of swinging the massive tower structure would be inordinately expensive and the 5-deg. simulator is being built at low cost. To eliminate the costly gearbox, a novel cable drive was designed. The cable is stretched around the outside of the single rail track under 28,000 lb. tension. A system of motor-driven pulleys takes the cable in at one side of the tower and pays it out at the other side.

This technique saves some weight



TESTS have begun on gimbaled assembly of Ames flight simulator centrifuge. Model below shows three-degrees-of-freedom gimbaled cockpit section at left and pulley system by which centrifuge pulls itself along cable stretched around perimeter of track.



In satellites and ground equipment, RCA space systems set outstanding performance record.

With its third consecutive satellite success, RCA Astro-Electronics Division has made "reliability" meaningful in space systems engineering and development. Read the "Reliability Record" for yourself.

December, 1958: Project SCORE. AED developed the communications and control systems for the U.S. Army Signal Corps' "Talking Atlas", part of a program under ARPA, Dept. of Defense. Transmitters, receivers and control units in the satellite and at the ground stations all operated perfectly as the "Talking Atlas" broadcast the President's Christmas message and proved the feasibility of active communications satellites.

April, 1960: TIROS I. The sophisticated satellite, including its structural design as well as the electronic systems, and its ground stations were developed and built for NASA by AED under the technical direction of the U.S. Army Signal Corps. It accomplished its mission in meteorological observation, sending down over 20,000 TV pictures of earth and its cloud cover.

August, 1960: Project ECHO. The only electronic equipment on this 100-foot balloon, launched by NASA to prove the feasibility of passive communications satellites, are two "dinner plate" beacon transmitters 10 inches across by 3/8 inch thick, including storage batteries and solar cells. These units, designed to permit beacon tracking of the satellite, weigh only 11 ounces apiece and were developed and built by AED.

As more and more sophisticated space systems are developed, AED will continue to design for reliability in this most demanding of all environments. To find out how you can draw on this dependable R&D capability, contact the Manager, Marketing, RCA Astro-Electronics Division. If you are interested in participating in this challenging team effort, contact the Employment Manager, Astro-Electronics Division, Defense Electronics Products, at RCA's "Space Center" in Princeton, N. J.

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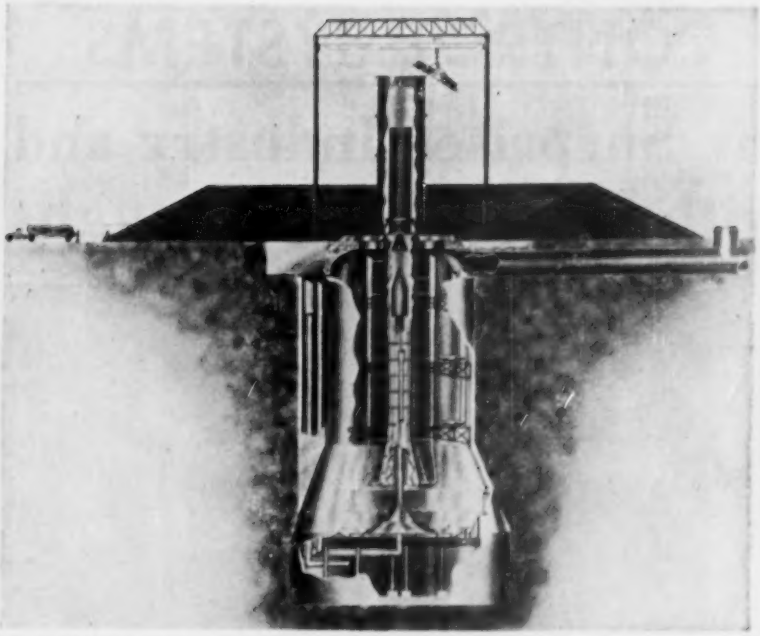


Cell to Test Rockets at Simulated Altitudes

Cell for vertically testing rocket engines of as much as 500,000 lb. thrust at simulated altitudes of more than 100,000 ft. is expected to be operational by early 1963 at Arnold Engineering and Development Center's Engine Test Facility in Tennessee. Cell may ultimately be able to test engines of up to 1.5 million lb. thrust without expending missile.

and cuts the power requirement by applying force at the perimeter rather than at the center. The track is 131-lb. per yard mainline railroad iron and the cable drive pulls the centrifuge tower along it at a speed of 52 mph. or 24 rpm. in either direction. The cockpit centerline is 7.5 ft. outside the circular rail. The pilot travels in a circle with a radius of 30 ft.

The two motors which drive the centrifuge arm were cannibalized from an earlier simulator and provide up to 2,400 hp. for brief surges of acceleration. The centrifuge is to reach its 6g radial acceleration maximum within 1 sec. from a standing start. With this rate of onset, the tangential acceleration is about 2.5g. Ames engineers say tests may show that the centrifuge can safely apply radial forces up to 10g to the 6061-T6 aluminum alloy structure, but for nearly all the experiments now foreseen, 6g should be adequate.

Total travel of the assembly which moves vertically on the tower is 13 ft. from top to bottom. At first it will be allowed to move freely only within a range of four feet. This is a pilot safety measure to prevent the assembly from slamming against the elevator stops. Vertical motion outside the four-foot band will damp out to zero before impact with the stops. Maximum acceleration upward will be 1g and the maximum downward will be 2g. Velocity maximum will be 11.3 fps. upward and 16 fps. downward. It is likely that the 4 ft. band of free movement will be widened when tests are complete. The vertical drive motor is like those used to drive the centrifuge arm. It is a d.c. motor with a maximum continuous rating of 150 hp. but it is capable of reaching 800% of rated torque or 1,200 hp. for a fraction of a second.

The three gimbal rings are driven by motor-generator sets from Navy surplus gun turret drives. Peak power levels at maximum acceleration are 50 hp. in yaw, 22.5 hp. in roll and 15 hp. in pitch. Angular travel is 360 deg. in either direction about the roll axis, 45 deg. in either direction about the pitch axis, and 180 deg. in either direction about the yaw axis. The maximum angular acceleration about the roll axis is 1,030 deg. per sec. per sec. to a maximum angular velocity of about 460 deg. per sec. Angular accelerations and velocities in the other two planes are much lower.

Friction drives are used to rotate the roll and yaw gimbal rings. This is a little surprising since the simulator is a servomechanism and cannot tolerate the least slippage because of the error it would create in feedback values. Ames engineers studied this problem carefully and have found no measurable slippage of the "silent chain" which transmits power to the gimbal rings. The silent chain is a broad, heavy band of toothed links, joined together in a manner somewhat similar to that used in bicycle chains.

(ADVERTISEMENT)

DATA AND CONTROL SYSTEMS

Young Company Surprises Industry and Competitors with Early Breakthroughs

Danbury, Conn.—A relatively young company, Data-Control Systems, Inc., has stolen the march on competitors with the production of the industry's first solid-state discriminator. In addition, the company has been in production for some time on a voltage-controlled oscillator, the AOV-3, which has been described as the "best in the industry", and a low level, smaller airborne oscillator, the AOV-10, which likewise appears to surpass anything currently on the market. Moreover, the company has just announced a new high impedance version of its electronic commutator, to meet the industry's coming requirements.

• **Data-Control Systems** was formed on October 1, 1957, just a few days before the announcement of Russia's Sputnik I. Since that auspicious day, the four original founders, including Dr. Robert J. Jeffries, a former president of the Instrument Society of America, have built an organization that today employs some 275 people. The Company's Research and Engineering Department, under the direction of Mr. Raymond A. Runyan, totals approximately fifty persons, and includes many of the country's outstanding designers of electronic data systems and measuring instruments.

Proprietary products include complete FM/FM telemetry airborne and ground systems including fixed and switchable subcarrier discriminators, reference oscillators, mixers, tape speed compensators, amplifiers, voltage-controlled oscillators, strain-gage oscillators, electronic commutators, calibrators, automatic standardization systems, sensing devices, data display devices and remote control links employing radio and wire transmission.

• **Several complete** ground-based data-acquisition systems designed and built by the young firm for the Boeing Airplane Company, Seattle, have just been delivered, and will be used for the R&D flight-test program of the "Minuteman" ICBM. Other customers of DCS include Aerojet-General, Arma, Chrysler, JPL, Lockheed, Douglas, North American Aviation, and Martin, as well as numerous military installations and university research centers.

• **The new solid state** FM/FM discriminator, Model GFD-3, exhibited at National Symposium on Space Electronics and Telemetry in Washington, D. C., is a logical outgrowth of the research in this field that DCS has pioneered from its very inception. For detailed information as to specifications, prices, etc., contact DCS directly: Dept. AW-10, East Liberty Street, Danbury, Conn.

DATA-CONTROL SYSTEMS INC. President, Robert J. Jeffries (left) checks installation of company's new transistorized subcarrier discriminator in Minuteman telemetry ground station just prior to shipment, while R. A. Runyan, V. P. of Research (right) and R. H. Hyde, Manager of Marketing, look on.

FOUR DCS PRODUCTS TERMED "WORLD'S FINEST"

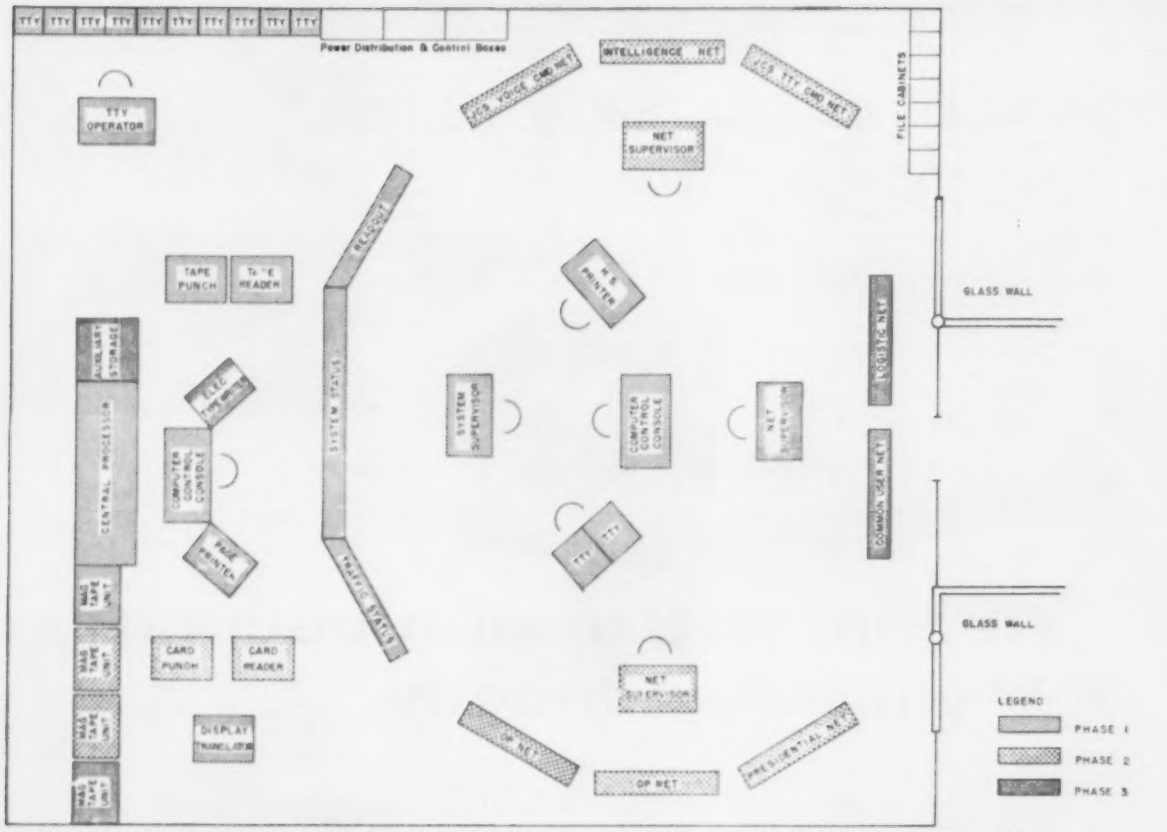
Dr. Robert J. Jeffries, President of DCS, describes his company's latest breakthroughs in these words: "We honestly believe that the Discriminator, Oscillators and High Impedance Commutator just announced represent the finest instruments of the type available today, from both manufacturing and state-of-the-art standpoints. We are proud to add them to our growing list of standard products which are bringing new standards of performance to research instrumentation systems."

GFD-3: Solid state compact phase lock loop discriminator; low power consumption, high power out; highly linear; ultra stable; extreme reliability.

APC-2: Solid state electronic commutator; high input impedance; low noise and cross talk. Unique modular construction permits wide range of switch points and sampling rates.

AOV-3: Solid state miniature voltage-controlled oscillator; long term stability; max. linearity; low distortion over wide temperature range.

AOV-10: Millivolt solid state miniature voltage-controlled oscillator combines best performance of DC amplifier and VCO into simple economical plug-in switch for strain gages, thermocouples, etc. Ultra stable over wide temp. range.



DEFENSE NATIONAL COMMUNICATION CONTROL CENTER to be constructed in Washington, D. C., will provide nerve center for newly created Defense Communications Agency to monitor and control all military long-haul, non-tactical communications facilities around the globe.

Center to Control Defense Communication

By Philip J. Klass

Washington—Nerve center for control and monitoring of the newly created Defense Communications System, an amalgamation of all military long-haul non-tactical communications facilities, will be constructed here next year in the Washington area by the new Defense Communications Agency (DCA).

The facility, which will be the cornerstone of a defense communication control system that will include eight or more regional control centers around the globe, will be known as the Defense National Communication Control Center.

Twelve companies and industry teams submitted proposals recently for the Washington control center. Timetable requested by DCA calls for the new center to go into operation by Mar. 7, 1961, with regional centers going into operation early in 1962.

Initially, transfer of data and communications between national and regional centers will be by manual or semi-automatic means. By July, 1963, DCA has asked for fully automatic data handling, transfer and display facilities.

When completed, the Washington control center will contain computer(s), displays and communications circuits which enable it to provide the following:

• **Composite picture of current status** of all Defense Communications System (DCS) circuits, channels, systems and facilities.

• **Indication of decreased performance** in portions of DCS and automatic computation of necessary corrective actions to obtain optimum communications despite lessened performance.

• **Prediction of DCS performance** in the presence of natural ionospheric disturbances (such as solar flares), man-made disturbances (such as intentional jamming or Project Argus type nuclear explosions in space), and catastrophic destruction of portions of DCS facilities. System is to be able to compute optimum system operating configuration needed to cope with such situations.

• **Recognition of catastrophic failures** in DCS, by continuously analyzing system performance, and determination of the likely cause of such failures.

• **Complete inventory of characteristics,** read out upon request, of DCS circuits, channels and subsystems, including such items as transmitter powers, distances, antenna and modulation characteristics, anti-jamming capabilities, physical vulnerability characteristics and similar types of information.

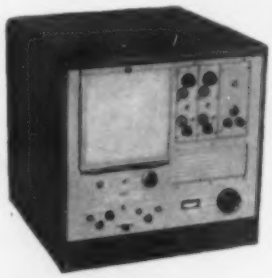
• **Computation of optimum location** and characteristics of new subsystems planned for DCS. Computation facility will also include capability for making communications traffic analyses and propagation-radio frequency predictions.

Data inputs to the control system will come from approximately 130 major DCS communication stations and facilities around the globe. Approximately eight regional control centers will serve as intermediate data collection-analysis-display points for localized monitoring

Here's the *only* X-Y instrument today that gives you extremely *fast response time — direct, large area recordings — 1% linearity:* the SANBORN MODEL 670A X-Y RECORDER. The capabilities of the 670A make it particularly valuable in such applications as rapid recording of diode and transistor characteristics . . . hysteresis curves for control systems, gyros, servo valves, magnetic coils; velocity or acceleration vs. vibration of mechanical elements.

Inputs to each axis are through interchangeable "850" series preamplifiers, and can range from microvolts to volts. With Model 850-1500A Low Level preamplifiers, 62.5 uv gives a 1" chart deflection; with Model 850-1300B DC Coupling preamps, 31.25 mv gives 1" chart deflection. To record one variable against time on the X-axis, the Model 670-800 Time Base Generator is also available. A plug-in MOPA is available to supply fixed frequency excitation to preamplifiers.

Recordings are made on 8" x 8" daylight-loading, ultraviolet-sensitive charts by an optical (light beam) recording system. The trace may be monitored on phosphorescent screen before recording, beam intensity is adjustable for maximum sharpness, and X and Y axes may be recorded directly on the chart. Brief post exposure in room light develops the record.



SPECIFICATIONS

Input: single-ended or push-pull

Input Impedance: 5 megohms from each high input terminal to ground with 850-1300B preamplifier

Frequency Response: to 130 cps within 3 db at 8" peak-to-peak deflection

Sweep Rates with Time Base Generator: from 0.01 to 2 seconds

Output Drift: 0.04 inch/hour with 850-1300B

Packaging: Optional cabinet 21¼" x 20" x 20" high, or can be rack mounted in 15¾" of panel space

Power Requirements: 450 watts, 115 volts, 60 cycles AC

Ask your local Sanborn Sales-Engineering Representative for complete information on the Model 670A X-Y Recorder, or write the Industrial Division in Waltham, Massachusetts.

Record 100th-of-a-second X-Y variables directly

- *at 2500"/sec. writing speeds*
- *on 8" x 8" charts*
- *with 1% linearity*
- *from microvolts to volts*

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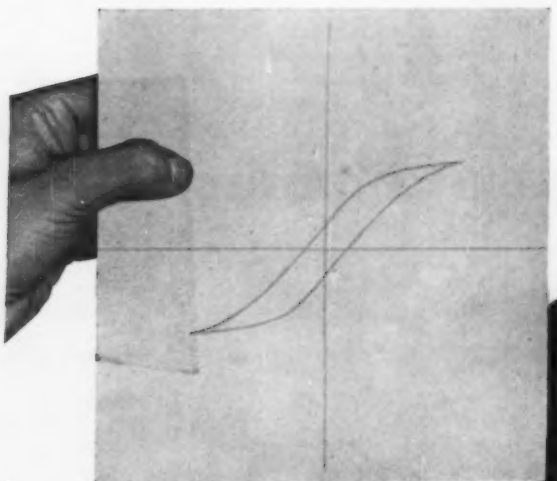
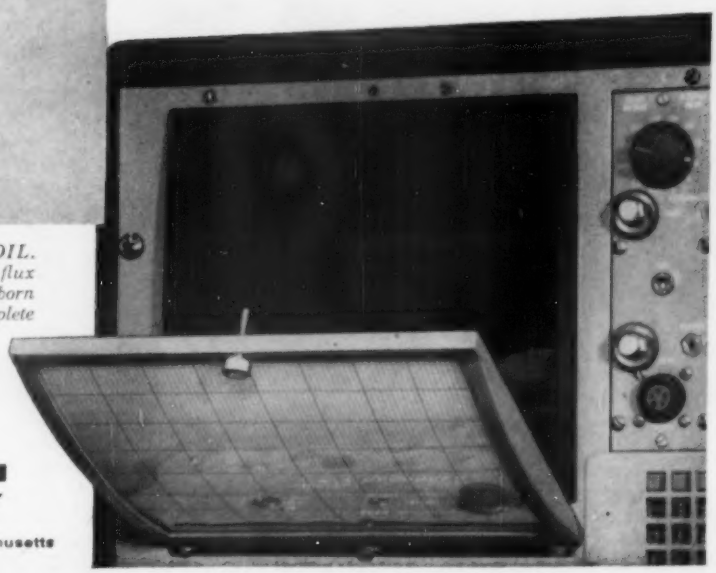


HYSTERESIS IN MAGNETIC COIL. This plot of magnetomotive force vs. flux density was recorded on the Sanborn Model 670A X-Y Recorder. The complete trace was made in 1/60th sec.



SANBORN COMPANY
INDUSTRIAL DIVISION
175 Wyman Street, Waltham 54, Massachusetts

REAR ADM. WILLIAM D. IRVIN, chief of new Defense Communications Agency.

of regional facilities. However, the centralized control will be the responsibility of the Washington center.

This group of regional and central control facilities will provide DCA with the mechanism by which it can exercise its authority to direct the operation of far-flung facilities now operated by the Army, Navy and Air Force as individual department facilities, and to integrate them into a single system which best serves the over-all defense needs of the nation.

This was the intent behind the formation of the Defense Communications Agency in May of this year. Another important objective is to minimize unnecessary duplication of facilities between the three departments, with resultant economies.

'Defense Bell System'

The new global military responsibilities thrust upon the United States during and following World War II resulted in the construction of what amounted to three separate global communications networks by the Army, Navy and Air Force. Although one service sometimes uses the facilities of another, where traffic loads and needs permit, the owner service naturally has first call on its facilities.

As a result, each military department has felt obliged to provide sufficient facilities of its own to meet at least its minimum peak operating needs. This has led to duplicate facilities, some of which have relatively low average utilization. Meanwhile, all three departments are seeking to enlarge their present facilities because of expanding needs.

The situation might be compared to one in which every company that made long-distance phone calls built its own private transcontinental landlines rather than effectively sharing such facilities with other companies through the me-

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High Capacity Saves Weight on Canadair CL-44

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This compact Bendix regulator is the lightest weight oxygen regulator designed for use in transport aircraft. Installed in the oxygen supply system, it automatically regulates oxygen flow and pressure to the outlets, providing undiluted breathing oxygen through an altitude range of 0-41,000 feet. This lightweight regulator will operate with inlet pressures from 50 to 2000 psi.

Type 29215 Oxygen Regulator can also be used as a high flow pressure reducer to deliver fixed gauge pressure, preset from 5 to 100 psig. Type 29238 Oxygen Regulator (basically similar, but with different calibration and mounting plate) has recently been approved for installation in a major U.S. commercial jet transport.

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SPECIFICATIONS

Weight: 1 lb. max.

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Outlet pressure tolerance: ± 2 psi throughout operating range.

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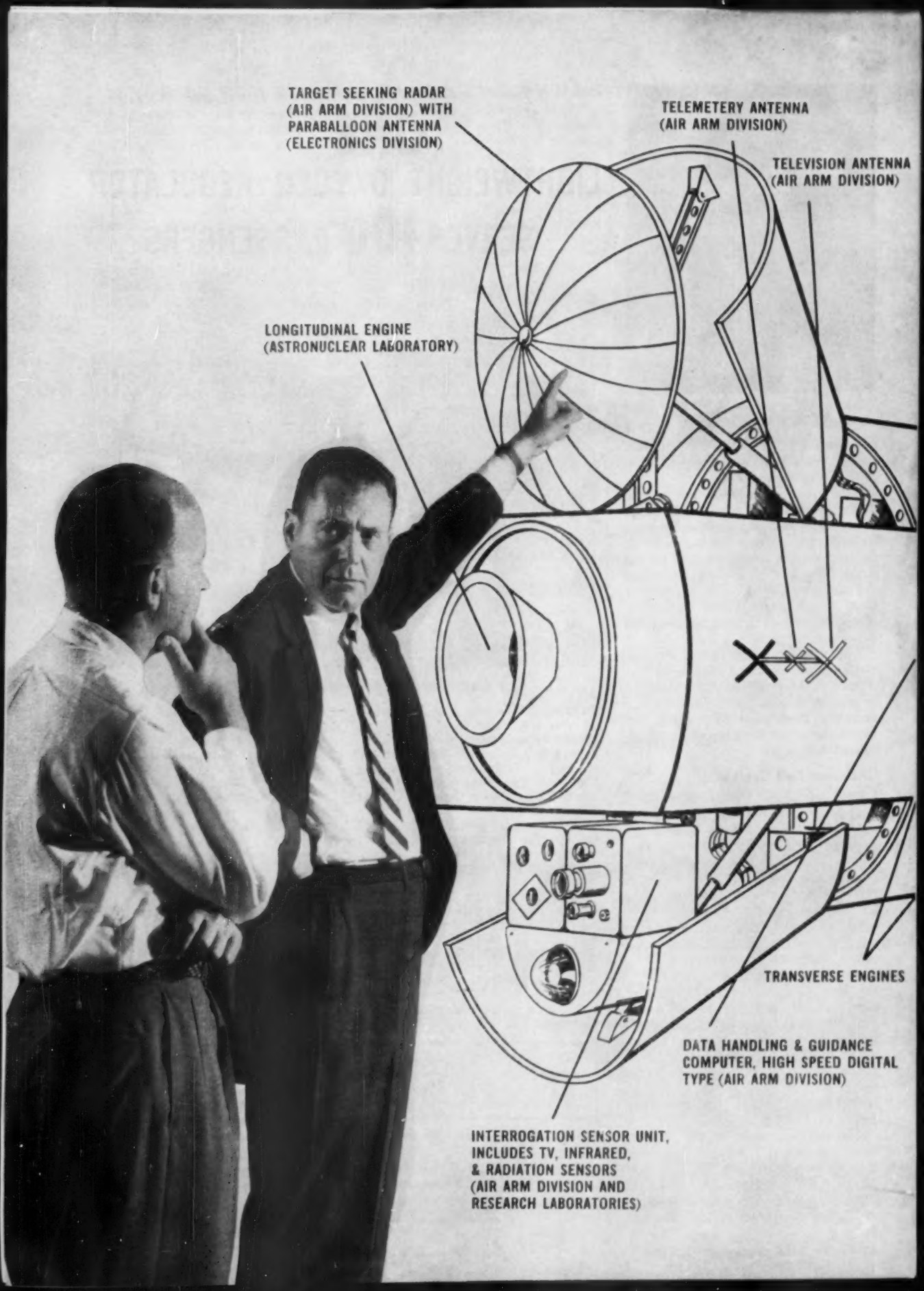
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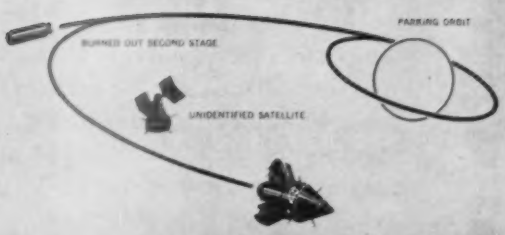
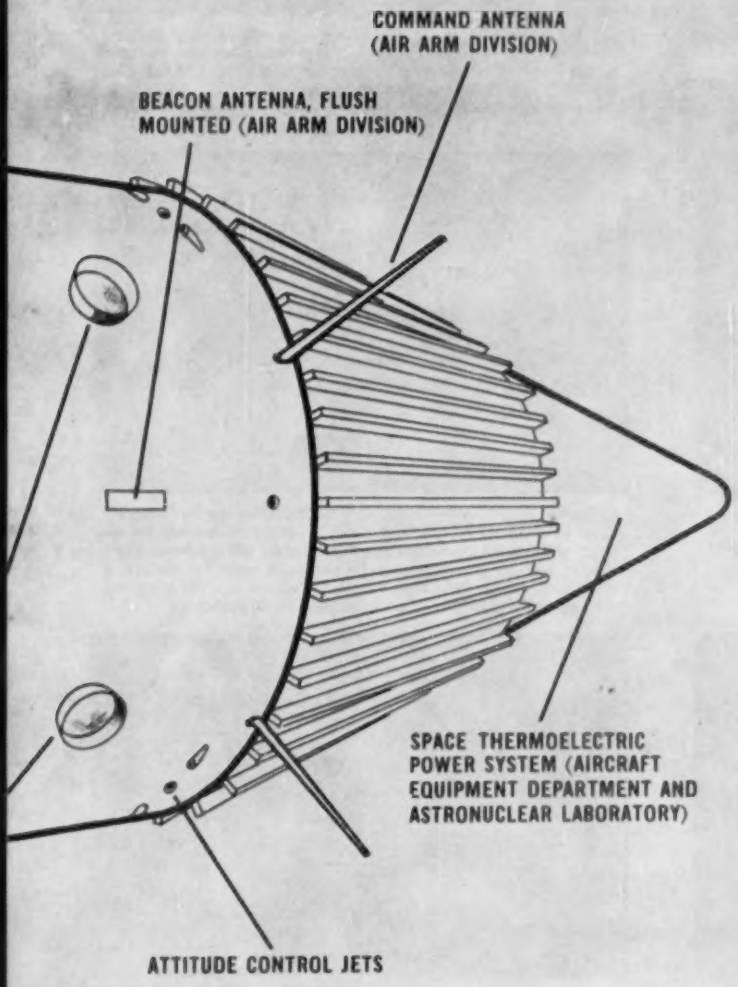


RENDEZVOUS SATELLITE


COMMAND ANTENNA (AIR ARM DIVISION)
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SPACE THERMOELECTRIC POWER SYSTEM (AIRCRAFT EQUIPMENT DEPARTMENT AND ASTRONUCLEAR LABORATORY)
ATTITUDE CONTROL JETS

This sophisticated payload is a concept encompassing Westinghouse capabilities for the space rendezvous mission. It incorporates the company's broad experience for radar target seeking, propulsion, stabilization and control, telemetry, thermoelectric power generation, high speed data handling, and TV and infrared sensors. Many of these systems are ready today. Others are advancing rapidly in development.

Such a satellite could be launched for immediate intercept, or placed into a parking orbit, always ready to intercept, interrogate or inspect in detail another object orbiting in space.

This payload, one of the many space mission requirements, demonstrates a capacity approached by few companies today. Westinghouse provides the full range of experience, facilities and engineering skill needed to produce pay-loads vital to the nation's space program. *You can be sure . . . if it's Westinghouse.*

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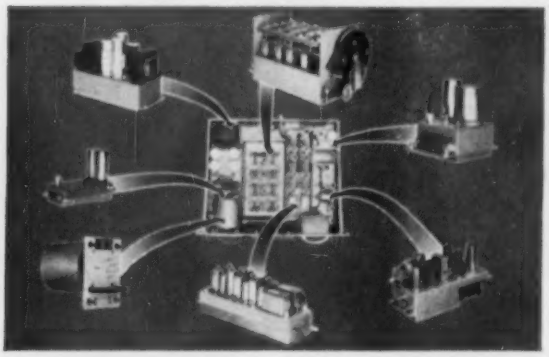
J-02320

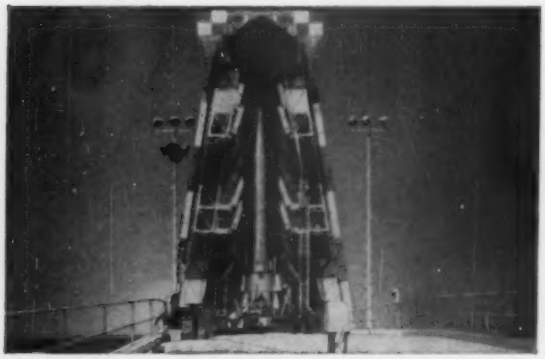
For more than a quarter century, Hallicrafters has worked in close partnership with our armed forces on fast solutions to critical military electronics problems. Out of this priceless experience are emerging startling new ideas and hard-hitting, fast-moving techniques to keep our country one jump ahead in electronic warfare . . .

B-52 and other military aircraft will be protected by the most potent Electronic Countermeasures equipments yet devised. These equipments were developed in close teamwork with the Air Force under Hallicrafters' QRC (Quick Reaction Capability) program. Now qualified to meet full environmental specifications, they are in quantity production.

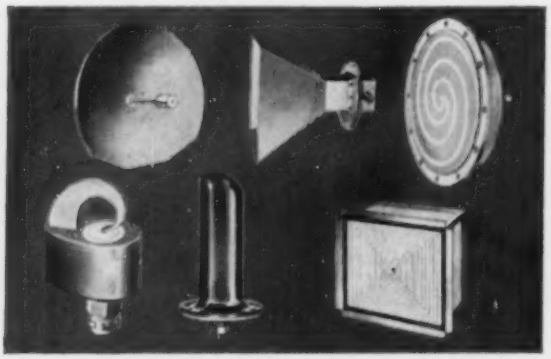
New levels of speed and efficiency are being reached in equipment modernization, retrofit and technical support programs with Hallicrafters' radical new "Blue Streak" project. Specially-trained Maintenance and Technical Support Teams, close-knit and flexible, can be tactically deployed to accomplish maintenance, installation and testing of electronics weapons systems anywhere in the world.



Hallicrafters communications leadership is exemplified by new high frequency Single Sideband receiver, (model no. SX-116). 100% modular design permits simple modification for compatability with existing and future communications systems. Stability, with proper available plug-ins, is better than one part in 10,000,000 per month. Hallicrafters also offers an existing capability in receiving and transmitting techniques up to frequencies of 50,000 megacycles.



Hallicrafters participation in the Atlas missile project helped to develop capability for many areas of the complex missile field, including code translator data systems; ground support equipment; ECM testing and antenna systems. Current explorations involve latest Infra Red techniques.



Airborne antennas and micro-wave components with power capability in excess of 1,000 watts, can be made available to solve tomorrow's very high power handling requirements. Testing of microwave components is possible with special high power generators, designed and built by Hallicrafters.

Looking for a challenging new opportunity? We are interested in qualified engineers at all levels. For full details in confidence, contact William F. Frankart, Director of Engineering.

For further information on Hallicrafters facilities and experience in military electronics research, development and production, please write to:

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dium of a national telephone company such as the Bell System.

The new Defense Communications Agency is intended to perform a function which in many ways is similar to that of American Telephone & Telegraph Co., with the individual military department facilities being comparable to the individual (local area) telephone companies that make up the Bell System.

About a year ago, the Army Signal Corps proposed that it be designated as a central agency to integrate and operate a tri-department global communications network. The proposal met with strong objections from Air Force and Navy. Because rapid, reliable communications have become increasingly vital to each service's operations, there is an understandable desire to retain control of such facilities.

To assure the three military departments that its own needs will be adequately considered, one-third of the professional staff will be drawn from each of the three departments. Rear Adm. William D. Irvin is chief of DCA and USAF Brig. Gen. James R. McNitt is his deputy. Three major directorates under Irvin are:

- **Plans and Programs,** headed by Col. Robert W. Paulson, Air Force.
- **Operations,** headed by Col. George Sampson, Army.
- **Research and Development,** headed by Capt. John Phelps, Navy.

The Defense Communications Agency reports to the Secretary of Defense through the Joint Chiefs of Staff. Under its charter, DCA is responsible for the operational control and supervision of the Defense Communications System which includes all worldwide, long-haul, government-owned and leased, point-to-point circuits, terminals, control facilities and tributaries required to provide communications from:

- **President** to and between Secretary of

BRIG. GEN. JAMES R. McNITT, USAF, deputy chief of Defense Communications Agency.

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Defense, the Joint Chiefs of Staff and other government agencies.

- **Secretary of Defense** and the JCS to and between military departments and the unified and specified commands.
- **Military departments** to and between their major commanders and subordinate fixed headquarters.
- **Unified and specified commands** to and between their component and subordinate commands.

Difficult Task

One of the new agency's first tasks may prove one of its most difficult in terms of its relations with the three military departments. This is the question of defining which of the existing communications systems and functions should be taken over by DCA and which fall into the category of tactical and weapon system control functions to be retained by the individual services.

For example, Strategic Air Command's "Short Order" single sideband system for rapid, direct communication with SAC bombers would appear to be excluded from DCA control under the terms of the original Defense Department directives. The SAC single sideband Commanders Network, which links headquarters with all major SAC bases, probably also falls into this category. But routine communications facilities between SAC headquarters and its far-flung bases might be a gray arr over which there could be a sharp difference of opinion.

After agreement is reached as to which of the individual department facilities are to become part of the integrated Defense Communications System, these will be transferred in title to DCA. The agency will then delegate the operation of such facilities, normally to the same service. But DCA will keep control and planning authority, according to Col. E. S. Maloney, (USMC), Irvin's executive officer.

Here are some of the operational control responsibilities which DCA will exercise under the new plan:

- **Allocate existing facilities,** based on approved requirements, to individual military departments, commands, Defense Department and/or other government agencies.
- **Allocate standby facilities,** both fixed and mobile, to meet emergency situation requirements and supervise the restoration and re-allocation of circuits under such conditions.
- **Operate control centers** which monitor availability status of all DCS facilities.
- **Prescribe standard procedures** for maintenance and installation practices.
- **Conduct traffic analyses** and periodic operational exercises to evaluate communication needs and effectiveness.

Plans and Programs

Under the new arrangement, individual military departments will continue to develop their own communication requirements necessary to meet their specific needs, and to obtain departmental approval for such requirements. It will not be the responsibility of DCA, for example, to question whether Air Force needs a certain number of additional teletype channels between Washington and England.

Possibly the Air Force's own needs could best be met using a communications satellite, but when the needs for additional facilities of other departments are taken into consideration, it might prove more economical to build a new submarine cable.

It will therefore be DCA's function to consider and analyze the over-all defense needs and situation economics, according to Col. Paulson, director of plans and programs. The agency will then recommend DCS expansion or additions which best meet joint service needs, and the military department it believes should be given the responsibility for developing the new facilities. This will be subject to approval by the Joint Chiefs of Staff and the Secretary of Defense.

During this month it is planned to have the unified and specified com-

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Navy Uses Transistorized Weather Forecaster

Navy fleet weather forecaster, new transistorized 1604 computer made by Control Data Corp., is providing twice-a-day forecasts based on raw weather data fed in by teletype from 5,000 station, including ships at sea. Data is stored in four Ampex tape recorders (rear). Facility is used by recently established Navy Numerical Weather Problems Group, Monterey, Calif. Forecast includes temperature, amount and distribution of precipitation and vertical velocity. Mission of weather problems group includes devising new techniques for weather and oceanographic forecasting for sub-surface, surface and air operations devising least-time routes for ships and aircraft and determining sea and atmospheric effects on radio, radar and sonar propagation-performance.

mands of the three military departments brief DCA headquarters staff on existing communications facilities and new facilities now programed or under development.

Present thinking is that DCA will not itself directly contract for research and development, except for the new control centers. Instead, DCA will work through the military departments. The agency will be responsible for coordinating research and development programs of the individual departments, which are applicable to the Defense Communications System, to insure effective integration, standardization and compatibility and to eliminate unnecessary duplication of effort.

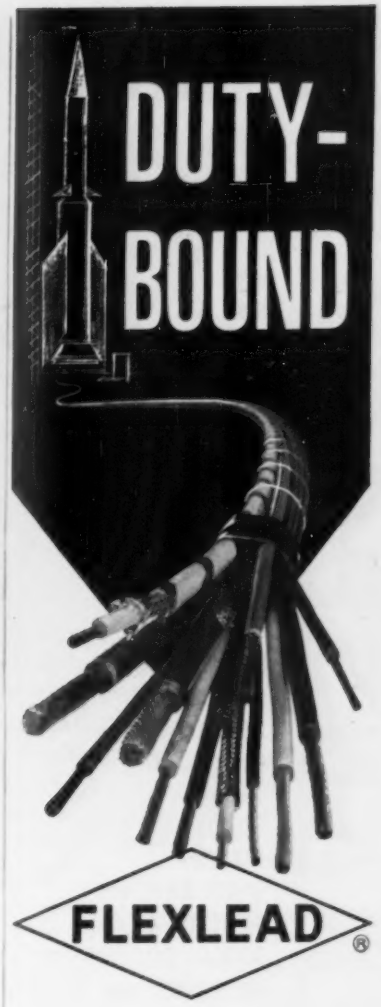
This assigned responsibility has prompted speculation as to DCA's possible future action on the Army UniCom and the Air Force AirCom (480-L) communication network development programs. Both these major projects had to run a hard gauntlet of Defense Department scrutiny for possible overlap-duplication before approval to proceed was granted last year.

Because of congressional concern over unnecessary duplication, DCA can be expected to re-examine both programs during the coming year. At present, both are in the study phase which is of relatively low cost. But as they approach design and fabrication, costs will rise sharply.

If DCA, in the course of its long-range system studies, finds that new hardware or techniques needed for future DCS use are not being developed by any of the services, it can recommend the launching of such programs to the Director of Defense Research and Engineering, through the JCS.

Presently authorized staff for DCA headquarters is 212, of which 95 will be officers, 28 enlisted personnel, 33 professional engineers and scientists and the remainder clerical. Of the authorized number, approximately 60 are now aboard.

The agency, presently housed in temporary quarters in northeast Washington, expects to move next month to the Navy Services Center in Arlington, Va., just south of Washington.



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▶ **Mesa Diodes Show Longevity**—Failure rates of less than one per million operating hours with 95% confidence level for mesa diodes have been demonstrated by recent Texas Instruments Inc. tests on batch of 900 mesa computer diodes selected at random from normal production. After accumulated total of 2,681,320 hr. of testing for the group, there was not a single failure, company reports. Reliability is attributed to more rugged construction inherent in the mesa design plus improvements in surface treatment, packaging and production controls.

▶ **Transistor Sales Stay on Plateau**—Semiconductor manufacturers sold 10.4 million transistors in June, an increase of 51% over same month last year. Dollar sales were $27.3 million, also up 51% over previous year, according to figures released by Electronic Industries Association. This is third month that transistor sales have failed to double previous year's sales, which has been the industry norm until very recently. (AW Aug. 1, p. 75.)

▶ **Novel Microwave Oscillator Developed**—Miniature oscillator that uses tunnel diode to produce frequencies ranging from 100 to 1,400 mc., with output of 0.7 milliwatt from 0.2 v. excitation, has been developed by Radio Corporation of America's Electron Tube Division. New Type SS-100 tunable oscillator weighs less than one pound.

▶ **New Semiconductor Device Announced**—New type of bistable semiconductor device, called the "binistor," which greatly reduces the number of components required for flip-flop circuit, has been announced by Transitron Electronic Corp., Wakefield, Mass. Flip-flop requires only one binistor plus three resistors, compared with conventional circuit which uses two transistors, seven resistors, two capacitors and two diodes. New silicon NPN tetrode binistor resembles a four-layer switch, but differs in that output current is obtained from an intermediate layer and the upper junction serves only as a "latch," rather than as a "lock" to hold device in conducting stage. The collector, emitter and base elements are used as in a conventional transistor. Binistors have been operated at temperatures ranging from −80C to 250C. Bulletin TE-1360 gives application data.

▶ **Tunnel Diode Prices Slashed**—General Electric has cut prices of its gallium arsenide tunnel diodes by 93%; units that formerly sold for $55 and $85 each are now available for $4.50 and $6.00 respectively. Five new types are priced at $7.50 to $18.00 each in large quantities. Company estimates that by 1962, prices of tunnel diodes will be less than $1.00.

▶ **Signed On Dotted Line**—Major contract awards recently announced by avionics manufacturers include the following:

• **American Bosch Arma Corp.**, Arma Division, $208,000 award from Wright Air Development Division to develop ultra-precise accelerometers for space vehicle guidance. Contract is result of earlier Air Force study program at Arma.

• **Fairchild Engine and Airplane Corp.**, Wyandanch, N. Y., $1 million contract for electronic countermeasures trainer, from Naval Training Devices Center.

• **Melpar, Inc.**, $200,000 award from Rome Air Materiel Area for ground support equipment for use with company developed electromagnetic analysis system.

• **Raytheon Co.**, Missile Systems Division, $2.5 million Navy contract for Polaris missile guidance computers using Weld-Pak type construction (AW Aug. 24, 1959; p. 104.)

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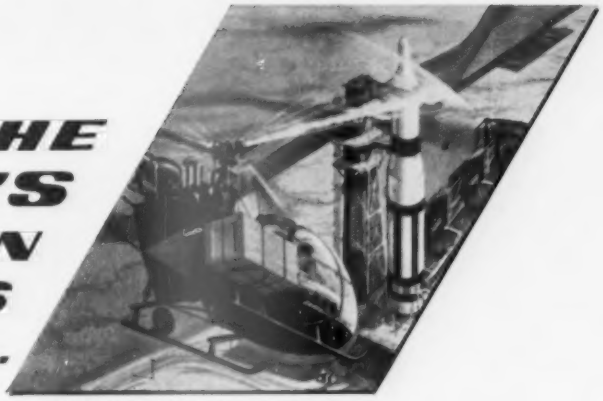

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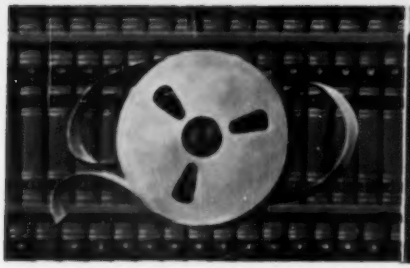
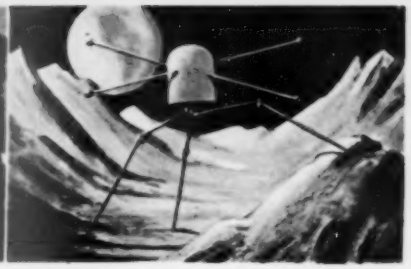
Aboard the nuclear submarine *Sea Dragon*, the first undersea magnetic video tape recorder will record and store data on under-the-ice characteristics from externally installed TV cameras. Upon return to base the recorded information will be displayed for the benefit of undersea service trainees, greatly increasing their understanding of hazardous polar navigation techniques. The recorder, a joint U.S. Navy-RCA effort, is a marvel of compact design (dimensions: 20″x 20″x 100″). It nestles securely in the limited confines of a torpedo rack, yet represents a 60 per cent space reduction over existing commercial video tape equipment. Designed to the curvature of the torpedo rack it will fit through the opening of a 24-inch hatch. Though small in size, the 4 megacycle recording it produces is fully compatible with its commercial counterpart!



Coming for business—a "video file system" capable of storing an entire encyclopedia on one 12½ inch reel, contents of which would equal 20 billion bits of information!

Coming for entertainment—the ultimate in color TV and video fidelity . . . via extremely portable recorders that will provide a panoramic view of world events virtually as they happen!



Coming for science—completely unattended recorders, robot-rocketed to the moon, will, on command, provide a detailed "picture" of space, free of the earth's atmosphere!

Other exclusive RCA recorder developments now contributing to national security include—the "Tiros" satellite recorder, designed for weather observation in outer space; a radar recording system to take the first pictures of a nose cone re-entry vehicle; a unique tape cartridge adaptable to *any* size recorder. For information on opportunities in creative engineering write: G. R. Gordon, **Defense Electronic Products,** Radio Corporation of America, Camden, N. J.

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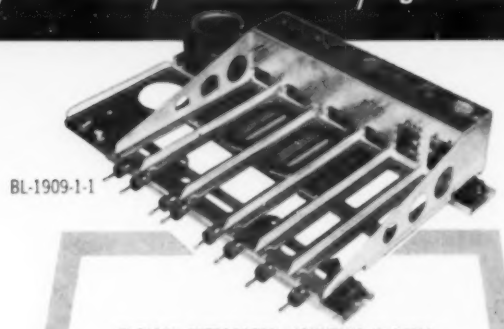

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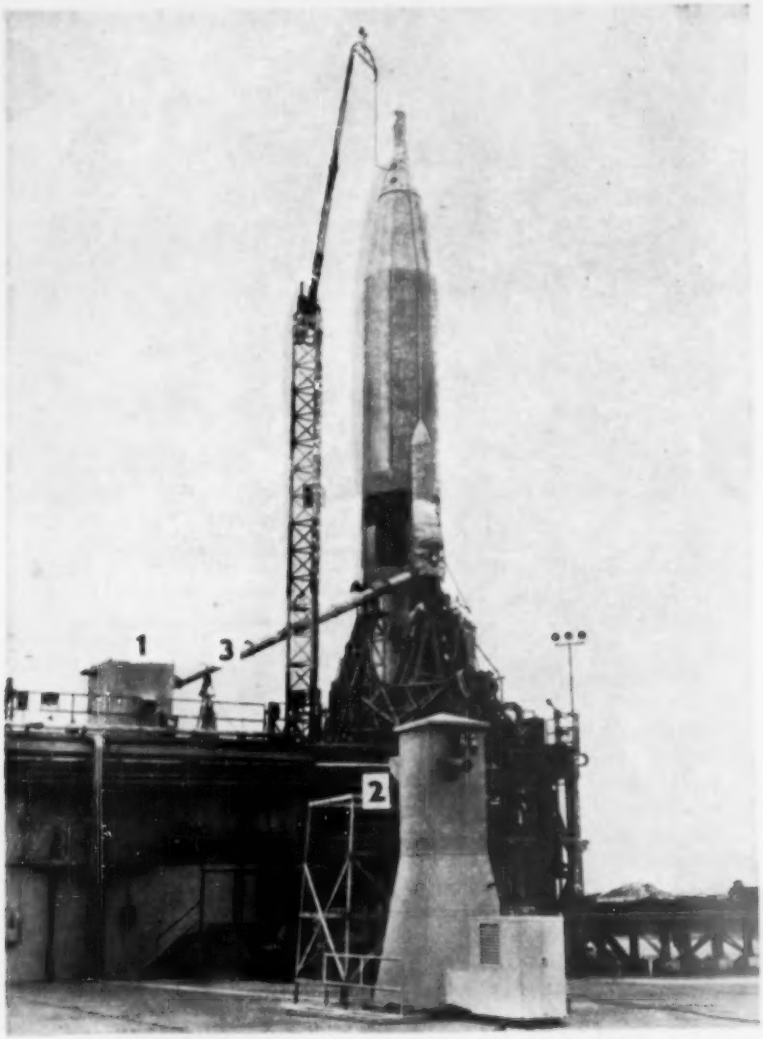
Atlas Guidance Aligned Optically

Norwalk, Conn.—First details on the optical system used to align the Atlas inertial guidance system in azimuth and keep it continuously aligned until launch have been disclosed by Perkin-Elmer Corp., which produces the system.

Reference for aligning the Atlas stabilized platform is an azimuth bench mark located in a steel-walled, air-conditioned shelf near the launch pad at the Atlantic Missile Range. (See photo.) Bench mark consists of a Poro prism mounted atop an 18-inch diameter pipe, with two-inch thick walls, driven approximately six feet into the ground for stability after being initially oriented by precise celestial survey.

A special optical theodolite, called an electro-collimator, is used to compare the azimuth alignment of the Atlas stabilized platform with the azimuth bench mark. Theodolite also can be used to make direct sightings on the North Star, if it is visible.

Twin light beams emanating from the theodolite pass through a 16-inch diameter, 35-foot long, double-walled tunnel connecting to the pod which houses the guidance platform and are



AZIMUTH ALIGNMENT of Atlas inertial guidance system stabilized platform, to precision required for accurate guidance, is accomplished by electro-collimator system shown above. Optical theodolite (1) housed in steel building uses accurate azimuth bench mark in pylon-shaped building (2) as reference. A 35-foot long tunnel, (3) connecting theodolite and missile guidance platform, carries twin light beams which are reflected off prism on platform. Deflection of beams produces signal which automatically realigns platform to required azimuth. Tunnel disconnects at launch.

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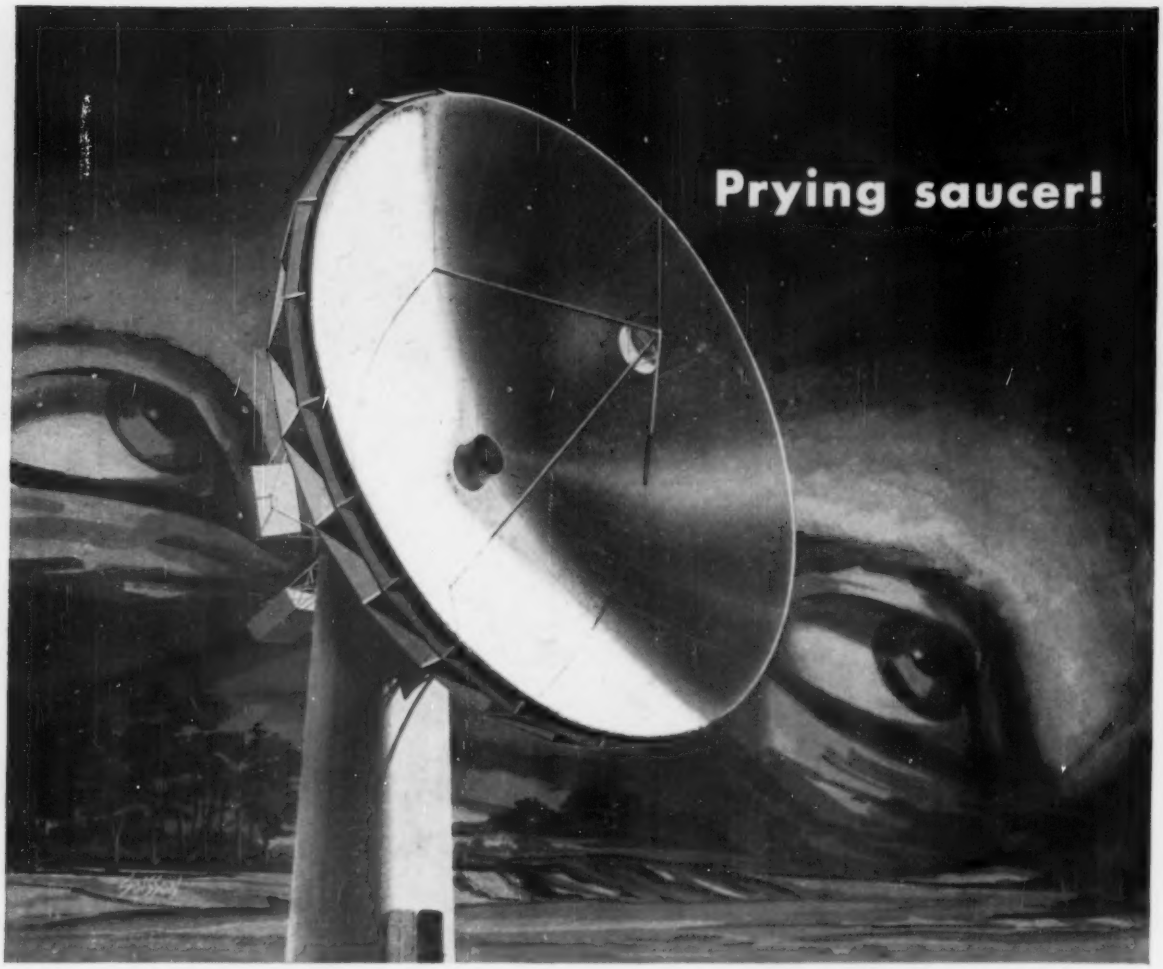

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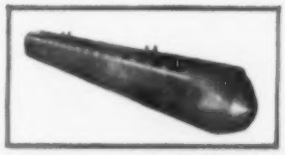
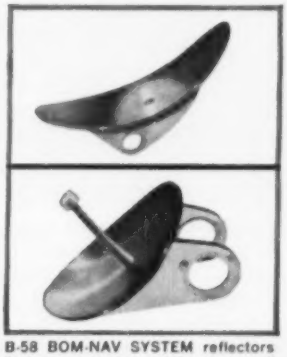
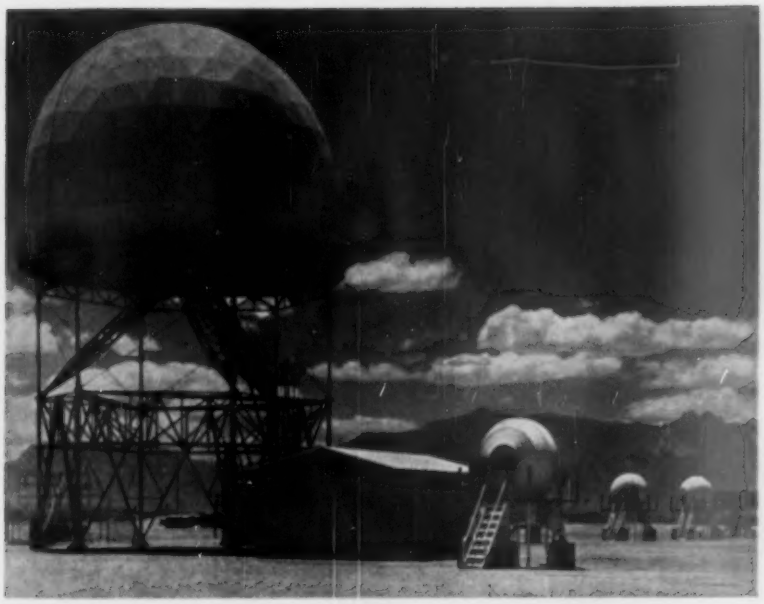


APS-94 ANTENNA SYSTEM included complete design of antenna for airborne side-looking radar.



B-58 BOM-NAV SYSTEM reflectors feature curvature tolerances of ±.005".



New Radar Improves Nike-Hercules Performance

New "Hipar" acquisition radar, which reportedly triples the defensive capabilities of present Nike-Hercules anti-aircraft missile, is shown at prototype installation at Army's White Sands Missile Range. The new radar, with peak power output in the multi-megawatt range, provides longer range, higher altitude coverage and narrower-beam to permit improved target definition. Radar was developed and produced by General Electric's Heavy Military Electronics Department, Syracuse, N. Y.

reflected back to the instrument by a mirror prism mounted on the stabilized platform. If the platform is not properly aligned in azimuth, the reflected beams pass through a slit in the theodolite's main prism and activate a photomultiplier tube.

This produces an error signal whose amplitude and polarity indicate the amount and direction of platform misalignment. Signal is amplified and fed back to the missile's guidance system causing the platform to move into correct azimuth position. Instrument continuously monitors and corrects missile platform azimuth alignment.

A shutter mechanism at the theodolite end of the tunnel closes automatically to protect the instrument from damage when rocket engines are fired, and a section of the tunnel near the missile falls away and retracts prior to the missile moving off the pad. Internal air temperature within the tunnel is closely maintained, by circulating air between inner an outer walls, to prevent distortion of the optical light beams and resultant errors in platform alignment. Steel-walled shelter for the theodolite also is air conditioned.

Perkin-Elmer is manufacturing the electro-collimators under a $1.5 million contract from Arma Division of American Bosch Arma Corp., prime contractor for the Atlas inertial guidance systems. The connecting tunnel itself is produced by Arma.

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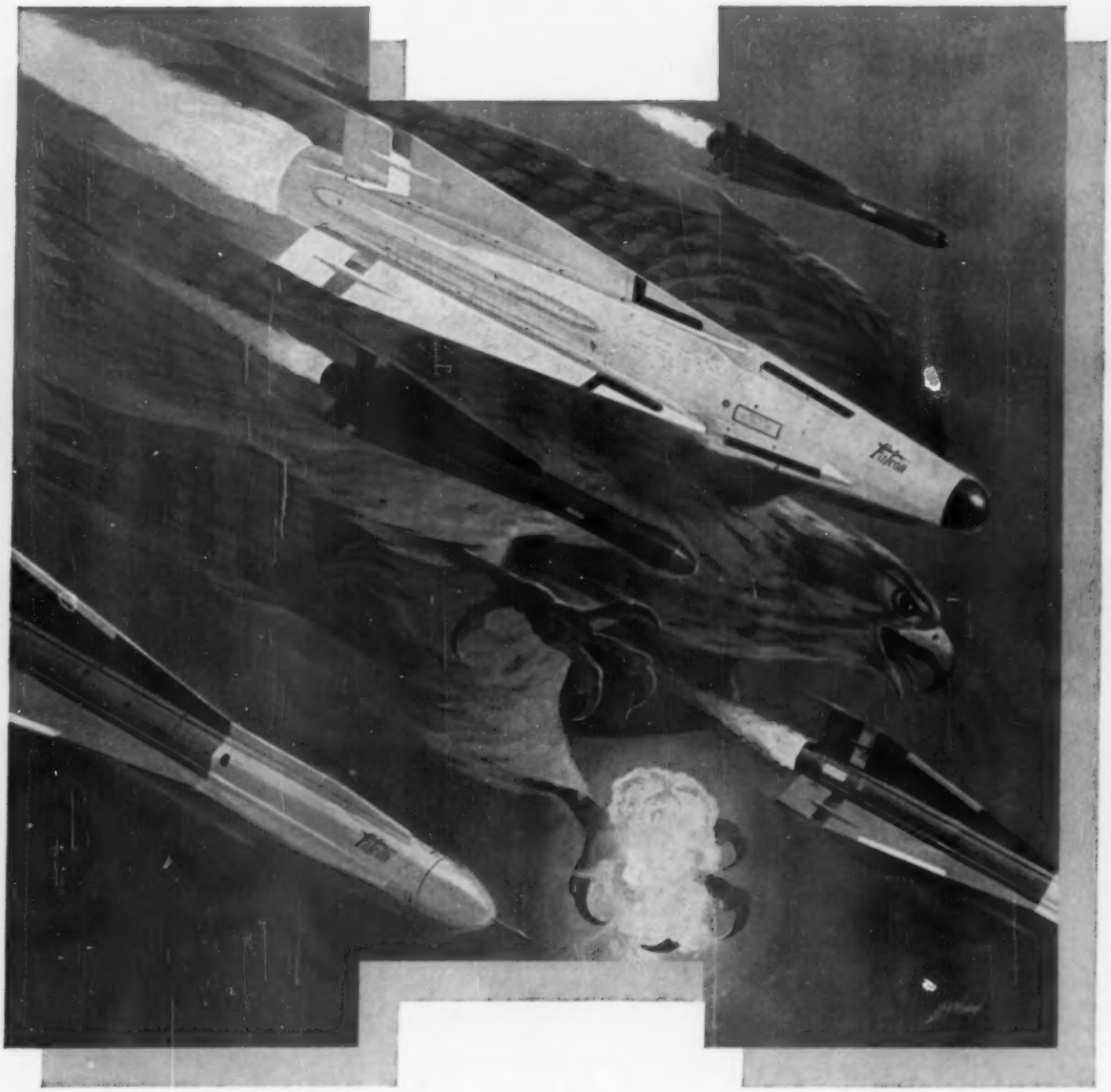

# of Falcons

The Hughes Falcon GAR-11 is the first air-to-air guided missile to pack a nuclear punch.

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The Falcon family has proven itself in operational service—every modern U.S. all-weather interceptor carries Falcon missiles. In simulated tactical firings Falcons have achieved unexcelled records for accuracy and reliability.

Like other Hughes weapons, systems and components, the Falcon is a product of Hughes' unique capabilities in virtually every area of advanced electronics. These include projects in space systems, airborne control systems, microwave communications, data processing and display systems, ASW systems, radar and IR detection systems—and many others.

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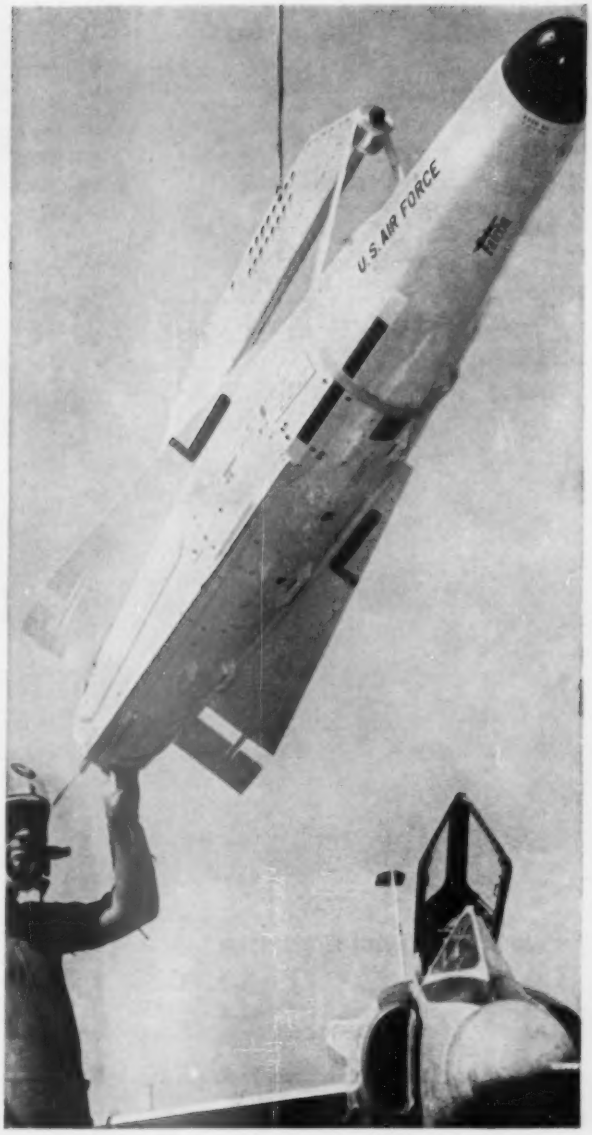

Larger than earlier Falcons, ***yet small considering its nuclear capability, the GAR-11 is 7 feet long, 11 inches in diameter and weighs slightly more than 200 pounds.***

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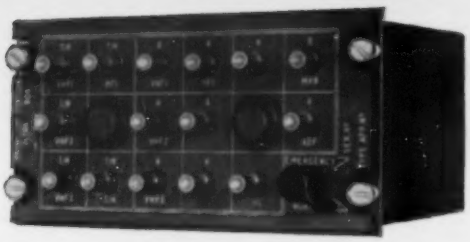

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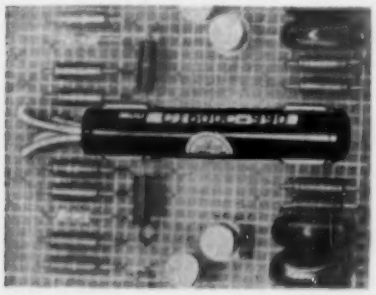
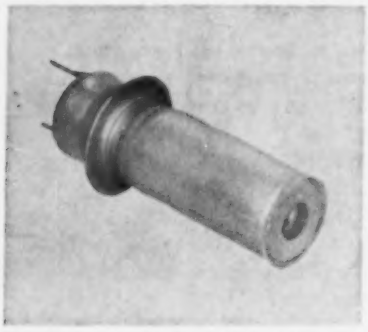


cps., accurate to within 0.01% over moderate temperature range. Unit can be operated over temperature range of −55C to 100C and is hermetically sealed. Manufacturer: Gyrex Corp., 3003 Penn. Ave., Santa Monica, Calif.

• **Indium antimonide infrared detector,** suitable for operating in the intermediate portion of IR spectrum with high sensitivity and fast response, can be used in terrain mapping or search-track systems. Detectivity of new cell is better than 4 x 10⁸ measured at 77 degrees



Kelvin, operating with a 500-degree Kelvin black-body radiation source, a 900 cps. chopping frequency and a 1 cps. bandwidth, according to manufacturer. ITT Laboratories, Component Sales, 3700 East Pontiac St., Ft. Wayne, Ind.

• **Velocity multiplier,** Model VM 1019, provides potentiometer shaft position determined by d.c. signal input level. Multiplier comprises reed chopper, subminiature tube amplifier, precision two-phase servo motor with integral gearhead with 70 to 1 ratio and a stack of four pots, two of which provide output data. Power input: 115 v. 400 cps, 6.3 v. 400 cps, 200 v.d.c. unregulated and

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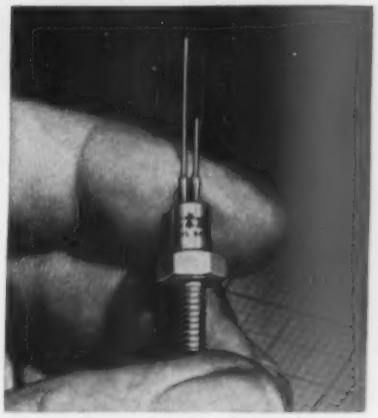
• **Voltage reference standard,** Series 230, provides dc. output reference voltage with temperature coefficient of 0.001% per degree centigrade over temperature range of −25C to 75C,

and regulation of 0.001% for 10% input voltage change. Output voltages of 5.7, 8.5 and 10.5 v.d.c. are available. Viking Industries, Inc., 21343 Roscoe Blvd., Canoga Park, Calif.

• **Subminiature lamps,** incandescent type, as small as ¼ in. in over-all length, with voltages ranging from 1.4 to 28 v., are now available from Hudson Lamp Co., 528 Elm St., Kearny, N. J.

• **Miniature silicon controlled rectifiers,** weighing as little as 0.1 oz., capable of performing mechanical-relay function with load currents of 1 amp., are now available with peak reverse voltage ratings of 20 to 200 volts. Units are hermetically sealed, have all-welded construction and measure approximately ⅜ in. in length, excluding leads. Bulletin SR-353 gives application data.



Price is $4.50 to $15.00, in quantities of 1 to 99. Manufacturer: International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.

• **Low-noise traveling wave tube,** Type Z-3028, for C-band operation, has maximum noise figure of 10 db. with average integrated noise figure of about 8 db. Minimum small signal gain is 25 db., power output is 5 milliwatts. Tube employs metal-ceramic construction, covers frequency band of 4-8 kmc., and is strengthened to withstand shock up to 50g and vibration up to 15g. It uses permanent focusing magnet and is convection cooled. Tube measures 9¼ in. long, 4½ in. wide,3 in. high and weighs 12 lb. Manufacturer: General Electric, Power Tube Dept., Schenectady, N. Y.

• **High-speed printer,** for readout from computers and data processing system, is available in two new series. The 4-1000-SD provides printing rates of 1,000 lines per minute of alpha-numeric characters or 2,000 lines per minute of numeric printing. The lower-cost Series 4-500-DD operates at 500 lines per minute for alpha-numeric characters or 1,000 per minute for numeric. Normal line length is 120 characters, but more or less can be provided if needed. Descriptive brochure is available. Manufacturer: Anelex Corp., 150 Causeway St., Boston 14, Mass.

• **Digital subtractor,** Model SU-100, for determining arithmetical difference between two digital inputs and providing voltage level outputs for operating lamp banks or mercury relays, also produces separate output signal indicating polarity (sign) of the difference. Either or both inputs may be parallel contact closures or voltage levels in decimal, natural binary or binary coded decimal format. Subtraction process is carried out in parallel except for carries. Operating speed is 50 microsecond per decimal digit. Unit is fully transistorized. Manufacturer: Datex Corp., 1307 South Myrtle Ave., Monrovia, Calif.

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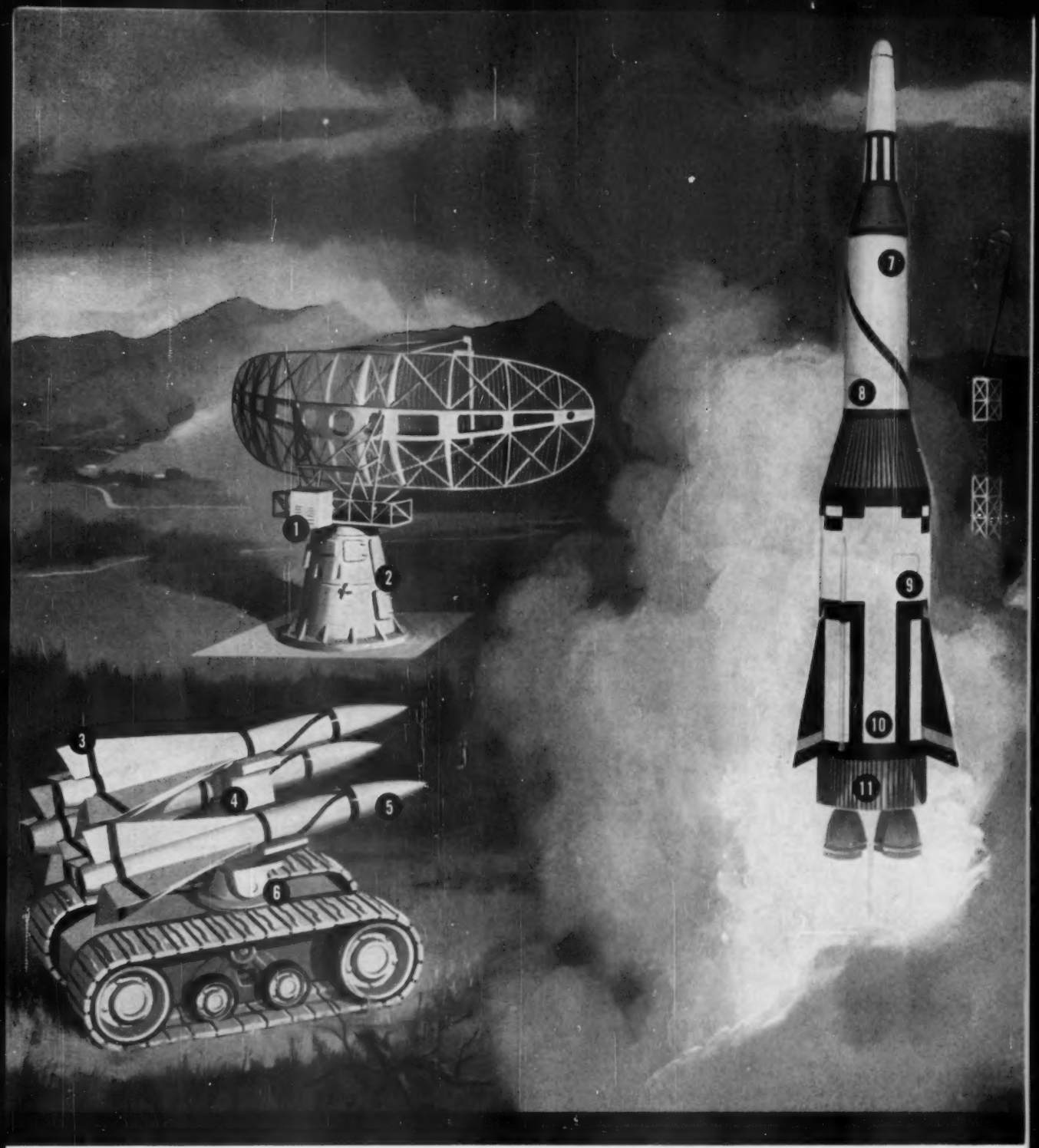

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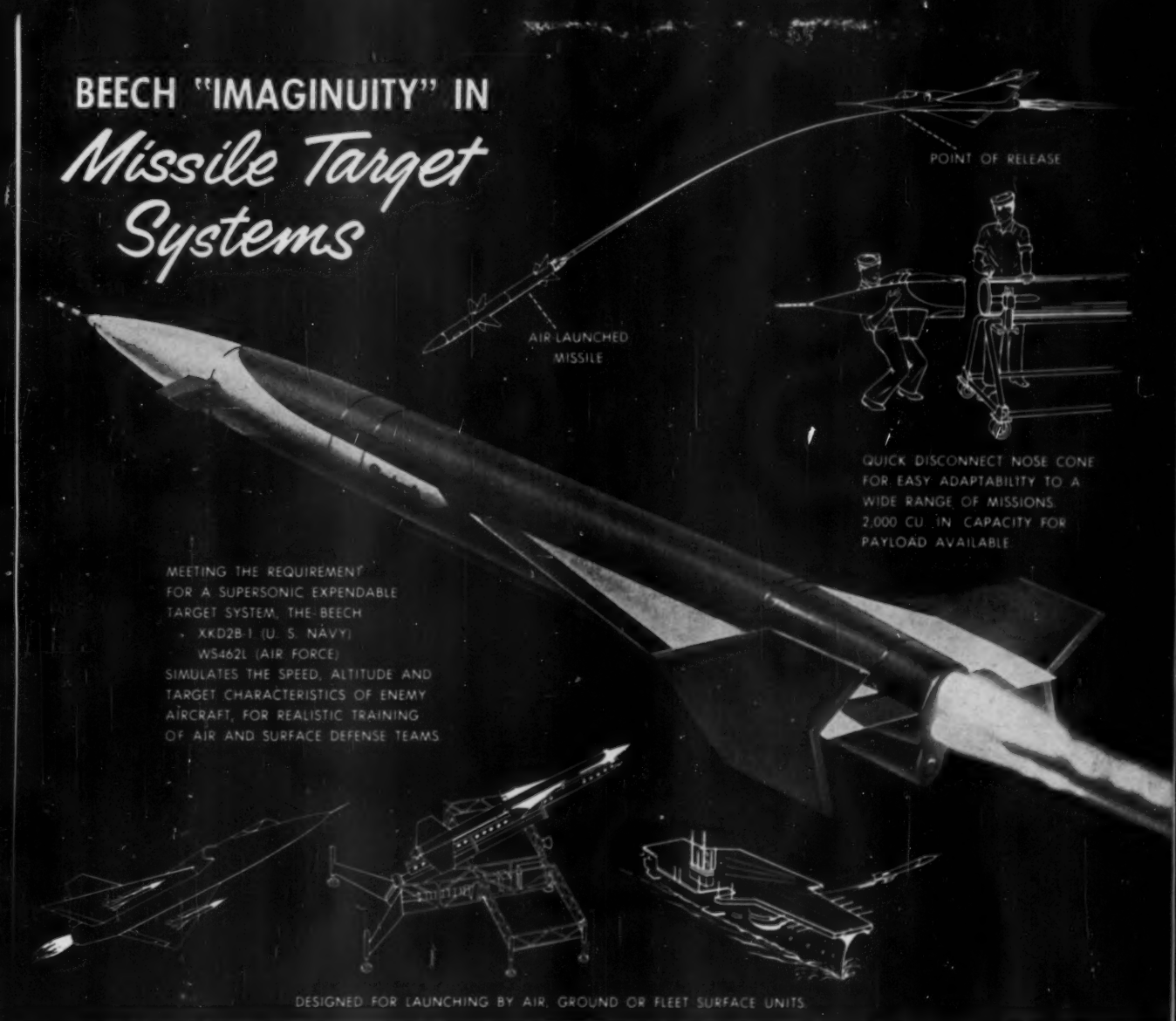
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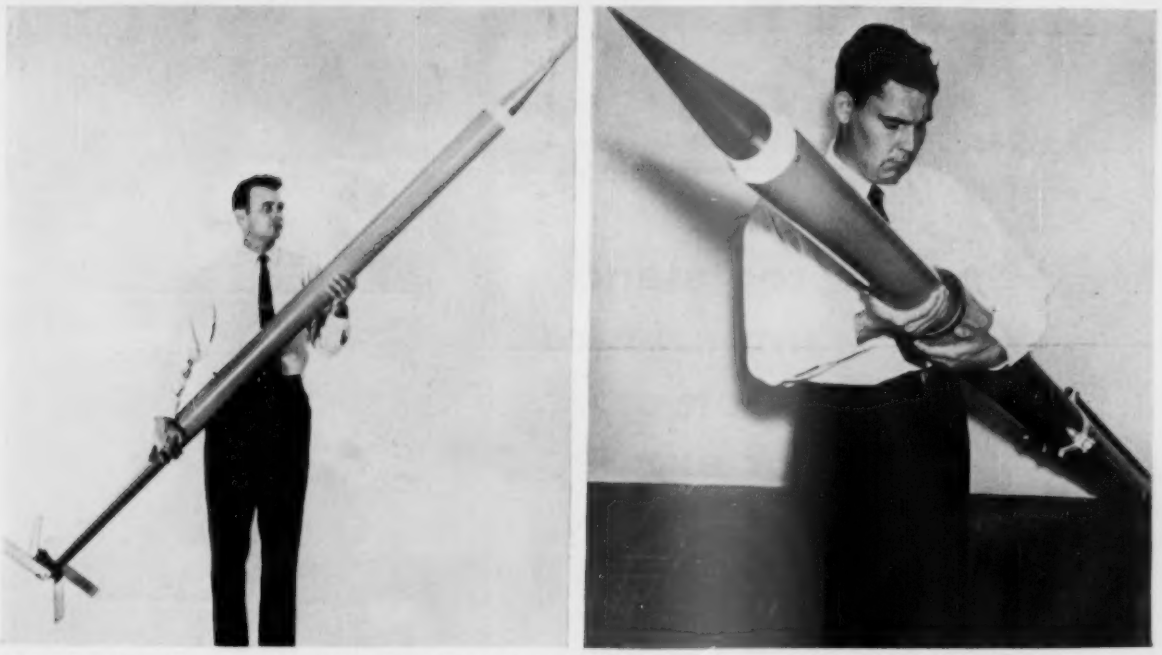


ROCKETDYNE sounding rocket (full-scale mockup at left) is about 105 in. long and has 4-in. diameter. At right the full-scale mockup is loaded into the combination shipping case-launching tube. Tube can be inserted in 5-in. gun or supported on ground by tripod or bipod.

Sounding Rocket Shipped in Launch Tube

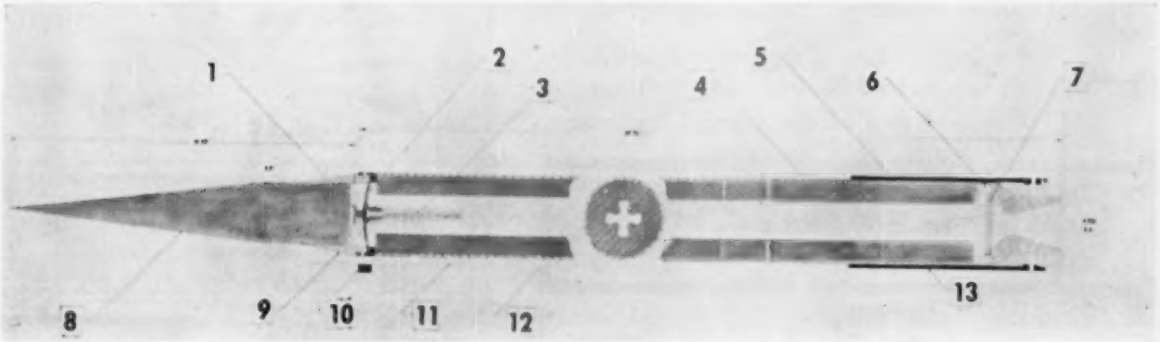
McGregor, Tex.—Simplicity of operation, reliability and low cost are prime features of a new weather sounding rocket vehicle designed here at Solid Propellant Operations of Rocketdyne Division, North American Aviation. Rocketdyne technicians are currently conducting market surveys to determine sales potential of the research vehicle.

Approximately 105 in. long and 4 in. in diameter, the rocket vehicle is designed to send research payloads of 6 to 18 lb. to altitudes of 230,000 ft. and 140,000 ft. respectively. The rocket can also be designed to retain the booster vehicle at burnout and separate the payload at peak altitude—this booster and payload combination would permit delivering a 4-in.-diameter nose cone weighing 6 lb. to 218,000 ft.

Normally, with a 6-lb. payload, separation of payload from booster rocket would occur at approximately 28,000 ft., where the payload will have attained a velocity of some 4,600 fps. Coast time of this payload to 120,000 ft. is estimated at 64.8 sec. Launch time to burnout is calculated at 14.4 sec. Total time for the payload to reach desired altitude would be about 79 sec.

Launching is designed to be a simple one- or two-man operation, using the reinforced plastic shipping container as the launch tube. This could either be set on the ground, using a tripod or bipod, or the tube inserted in a five-inch naval gun.

The propulsion system, using mild steel tubing in the annealed condition and a cast nozzle with essentially the same properties, has a hardware weight, excluding payload, of 22.46 lb. A 0.050-



CONVENTIONAL thin-wall tubing forms case of Rocketdyne sounding rocket vehicle; fairings and insulation are molded. Case head is a stamping. Cross-section of four-point star-shaped motor is in center of drawing. Figures show: 1—separation latch; 2—head stamping; 3—igniter assembly; 4—grain (Rocketdyne propellant R-127A); 5—restrictor; 6—molded insulation; 7—ignition aid burst disk; 8—payload; 9—molded phenolic fairing; 10—igniter plug; 11—strip spacer; 12—launch tube; 13—fins.

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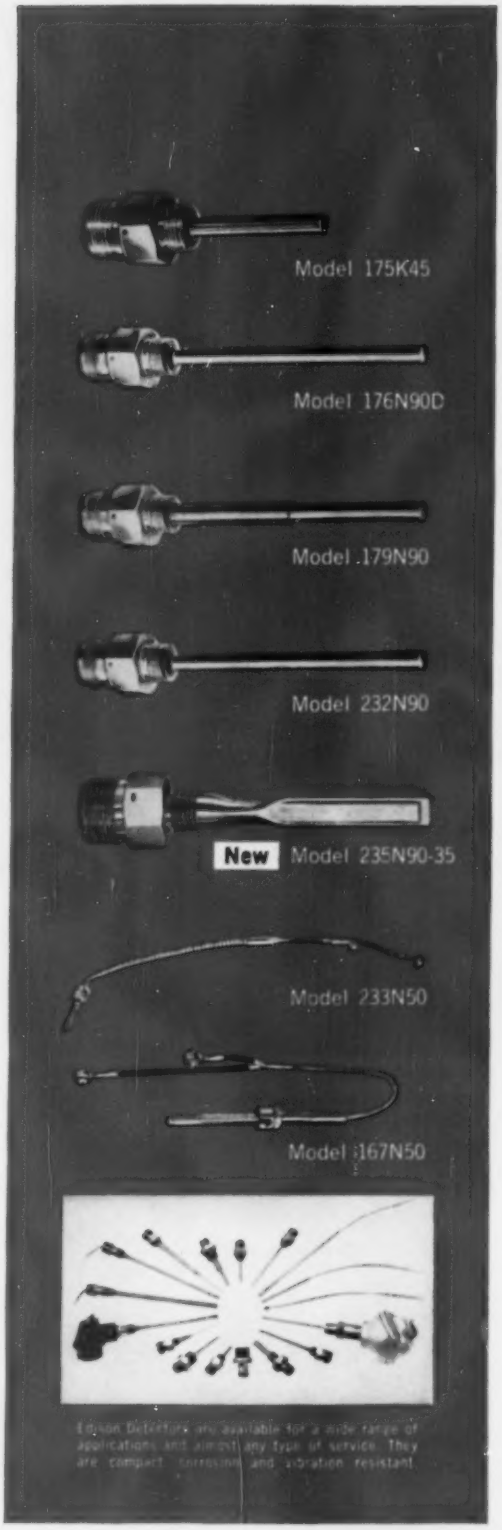

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in. case wall thickness would provide a safety factor of two with chamber pressure during motor firing being progressive and peaking at 800 psi. An optimum 0.040-in. wall case would be desirable for weight savings and increased performance.

The cast steel nozzle would be heliarc welded to the tubular body; prior to the welding operation, a phenolic molded insert and plastic burst diaphragm are bonded to the upstream side of the nozzle. This diaphragm is designed to rupture completely at 300 psi. chamber pressure, leaving no particles to restrict nozzle flow. Two 0.020-in. holes would be drilled through the burst diaphragm for the igniter wires.

Phenolic blocks, also acting as spacers, support the folding fins to the nozzle. Roll pins lock the blocks in position and act as stops when the fins are in full-open position.

The magnesium fin blades open to a span of 18.75 in. and are designed so that alterations of the fins can be made readily without changing the basic configuration.

The head closure consists of a metal stamping fastened with 10 rivets of blind drive seal type. The head supports the igniter assembly and payload release mechanism. A rubber seal between head and motor case provides a pressure seal and also provides space for propellant expansion during temperature cycling.

All components of the rocket booster are planned as standard purchase parts and commercially available materials.

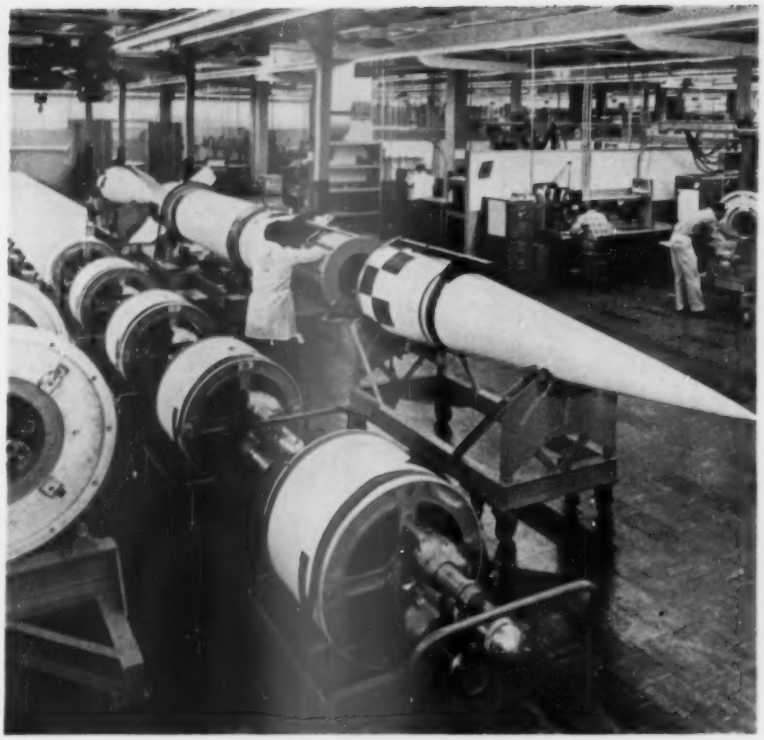
Cluster Arrangements

The basic design also lends itself to cluster arrangements, according to SPO technicians.

Rocket motor uses a standard SPO formulation (RDS-127A), which is basically an extruded rubber-based ammonium nitrate propellant having a burning rate of 0.11-in./sec. at 70F and 800 psia. Flame temperature is 2,340F. Propellant gases are non-toxic and smokeless. The charge is made in two 41-in. sections with an overlapping of R-106D restrictor material where the grains are nested to provide case protection at the break. Adhesive is applied at a portion of the outer surfaces of the grain to prevent movement during motor firing.

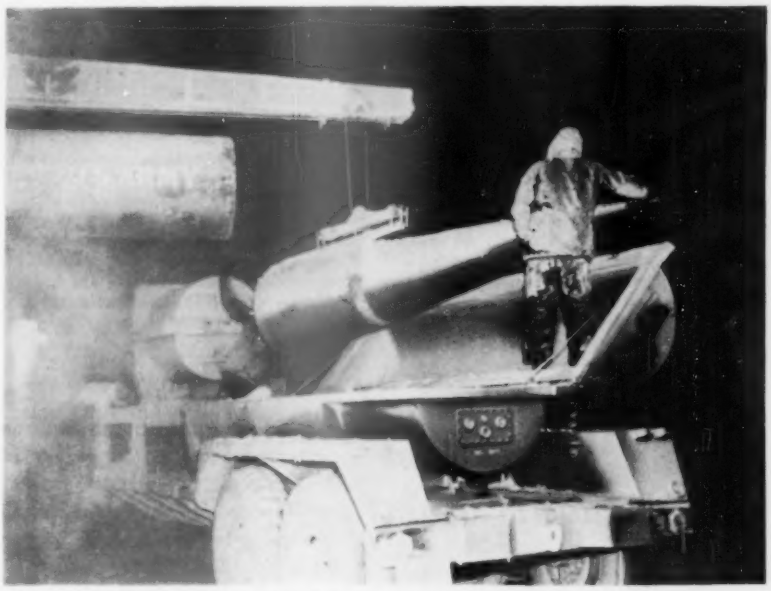
To provide a 12.7-sec.-duration 660-lb.-thrust with RDS-127A, an internal and end-burning four-point star-shaped grain configuration is utilized, providing maximum thrust and internal pressure at burnout time, when the vehicle is in the thinner atmosphere to minimize effects of aerodynamic drag at the lower altitudes.

Propellant formulation is a well-proven type used in thousands of JATO



Sperry Utah Tests Sergeant Systems

Army Sergeant medium-range surface-to-surface missile is shown on the final checkout section of the assembly line at Sperry Utah Engineering Laboratory, where it is in production for test purposes. Sergeant is broken down to four sections for transport on its mobile launcher; major sections can be checked out while in their pressurized containers. After firing, range is controlled by guidance programing and by activation of petal-shaped drag brakes which are flush with the midsection.



Sergeant systems are checked for cold weather operations in a special hangar at Eglin AFB, Fla. Other tests are made at Sperry Utah's new environmental test laboratory at Salt Lake City. These include extremes of sand, dust, fungus, salt spray and altitude. Another test involves random vibration, set up by a C-200A shaker. Components are tested at up to 53,000 lb. instantaneous peak force.

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rocket motors that are produced here.

With the rocket fired from a closed breech tube launcher, the captive gases in the tube serve to augment the rocket motor thrust and breech exit velocity is estimated at 200 fps., a speed deemed necessary to stabilize the rocket in crosswinds up to 60 kt. Acceleration and breech velocity of the rocket can be readily varied by placing a properly-selected length of spacer tubing at the bottom of the launcher. Calibrated position markers on the rocket body index the free volume area.

Gases expanding from the ignited rocket motor are held in the launcher tube by a sectioned seal plate located on the nozzle's aft portion. These compressed gases drive the rocket from the launcher tube, the seal plate falling free as the vehicle leaves the tube.

Acceleration, after closed breech tube launching, will build up from 6g to 29.4g at booster burnout, depending somewhat on payload weight.

Payload separation from the vehicle is accomplished by a simple two-position latch system. The payload is attached by pushing it into the vehicle with a slight pressure until the latch is actuated to hold it firm. The effect of acceleration loads during firing compresses the payload section further into the vehicle, causing the latch to unlock. With thrust and g-load diminishing between one and three, a compressed spring will push the payload free. Aiding in the separation are effects of weight-to-drag ratio of 2½:1 of payload to booster.

Trailblazer Rockets Gather Re-Entry Data

Washington—Two six-stage Trailblazer rockets were fired recently from Wallops Island, Va., in renewal of basic re-entry dynamics research being conducted by the National Aeronautics and Space Administration and Massachusetts Institute of Technology.

The studies, which began last year, are designed to investigate charged particles which surround objects entering the atmosphere at high velocity, blanking out communications and increasing radar image. Launches last week were the sixth and seventh in the Trailblazer program, and they involved ionization measurements using re-entry bodies made of different materials.

Spherical solid rocket, used both as final stage and re-entry body, had a titanium case in the sixth test. In the seventh test, the rocket case was made of phenolic nylon ablating material.

Trailblazer launch vehicle consists of two sections: first three stages boost the vehicle to its maximum altitude, and final three stages drive the 5-in. dia. motor back into the atmosphere

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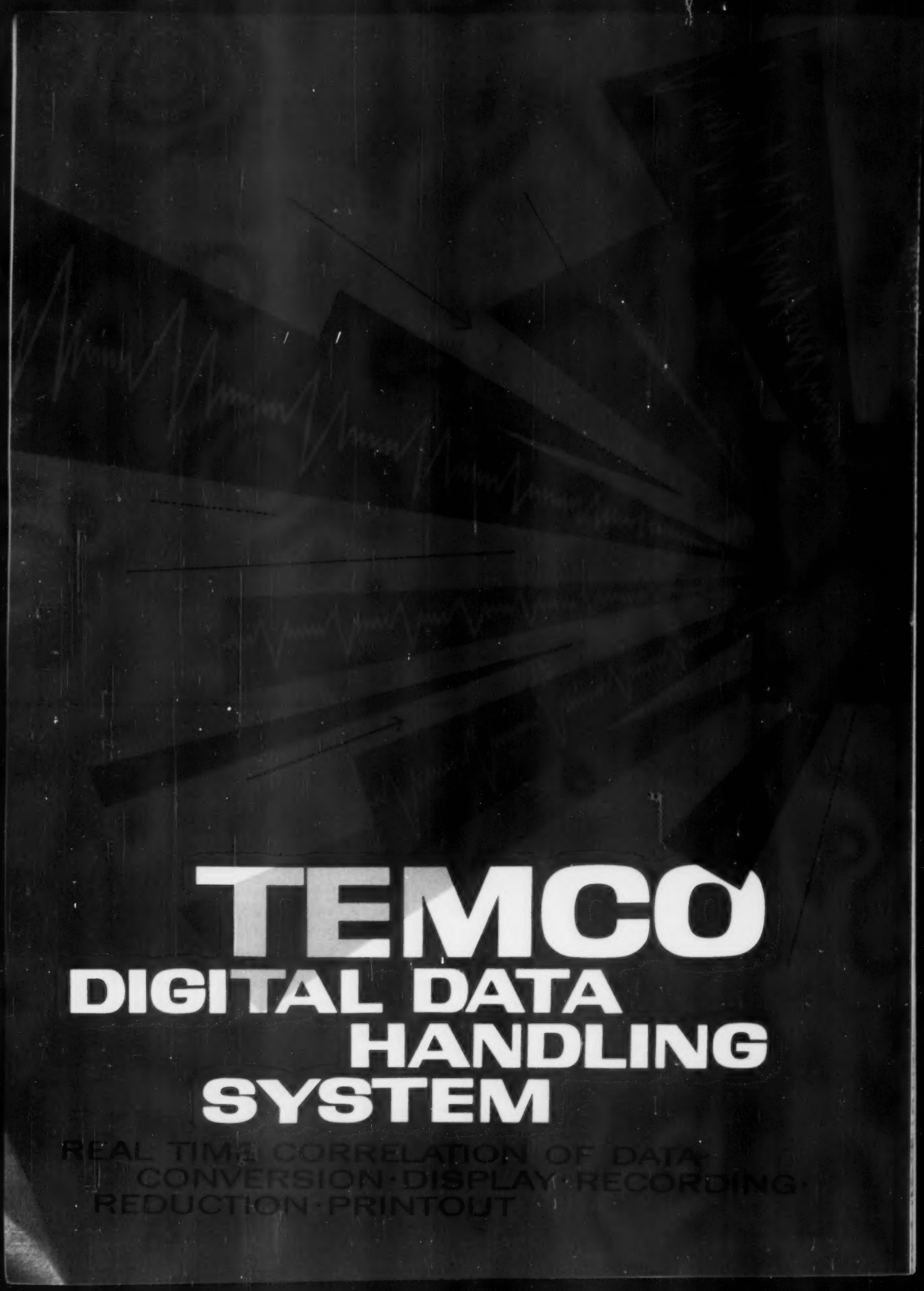
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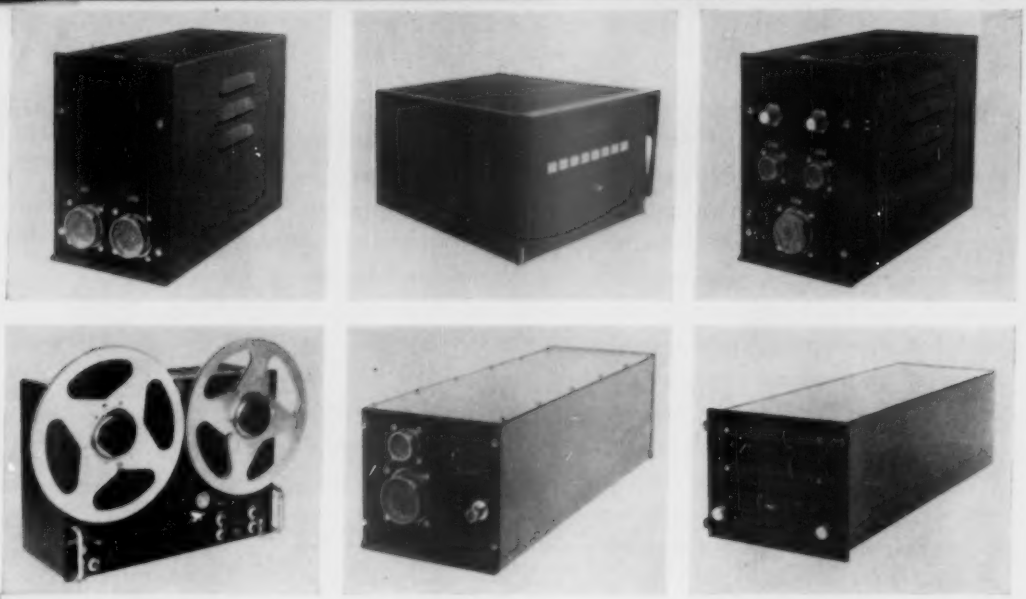

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The first warning alerted posts all over the United States and Canada. Unidentified airborne objects seemed to be approaching at supersonic speeds from many directions. ¶ Simultaneously in control centers throughout North America men and machines dealt with torrents of data. Watching blips on radar scopes, crews made decisions which ordered weapons to destroy the attackers. Interceptor pilots reported over loudspeakers. As the enemy reacted and shifted, fresh instructions crackled through command phones. ¶ But no rockets were fired. No bombs fell. The blips came from magnetic tapes made by a single high-speed computer. Called Operation Desk Top, this was a simulated raid—the most gigantic ever arranged—to exercise the North American Air Defense System. In planning it, SDC made four billion calculations and six and one-third miles of magnetic tape. ¶ To train managers in decision-making, to exercise decision-makers under realistic stress, to avoid costly errors in actual operations—these are some of the purposes of SDC's pioneering work in systems research and development. ¶ **SYSTEM DEVELOPMENT CORPORATION.**

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SDC

at re-entry velocities. Apogees in recent tests were 180 and 190 mi., and both re-entry bodies attained a velocity of 15,000 mph.

NASA-MIT team received data on cross-sectional ionization and optical radiation effects of the ionized layer from radar, cameras and doppler telemetry. Flight transmitters were wrapped around spherical motor nozzles.

Spherical motors used in the Trailblazer project were designed and developed by NASA's Langley Research Center. During re-entry, they are consumed by atmospheric friction.

In addition to the spherical motor, the all-solid launch vehicles consist of an Honest John-Nike-TX77 (Lance) used in the three-stage booster, and a T40 and T55 re-entry boost section. Launch system is 55 ft. long and has a liftoff weight of 7,700 lb.

Westinghouse Receives Project Press Award

Western Electric Co. will link Kwajalein and Roi Namur in the southwest Pacific with submarine cable systems to be utilized in Project Press, a test program for detecting and identifying ballistic warheads (AW Apr. 11, p. 83).

The company received a $1 million contract from the Department of the Army for installation of a 55-mi.-long cable system for communication and data transfer between the islands. Radar will be installed on Roi Namur, 45 mi. from Army's Nike Zeus installation in Kwajalein Atoll.

In the experiment, unarmed target missiles will be launched from Johnston Island, 1,402 mi. from Roi Namur, so that the exo-atmosphere and terminal physics of ballistic missile flight can be studied.

Atlantic Research Studies Ramjet Fuel

Washington—Atlantic Research Corp. has a Wright Air Development Division contract to develop high volumetric heating value slurry fuels for ramjets.

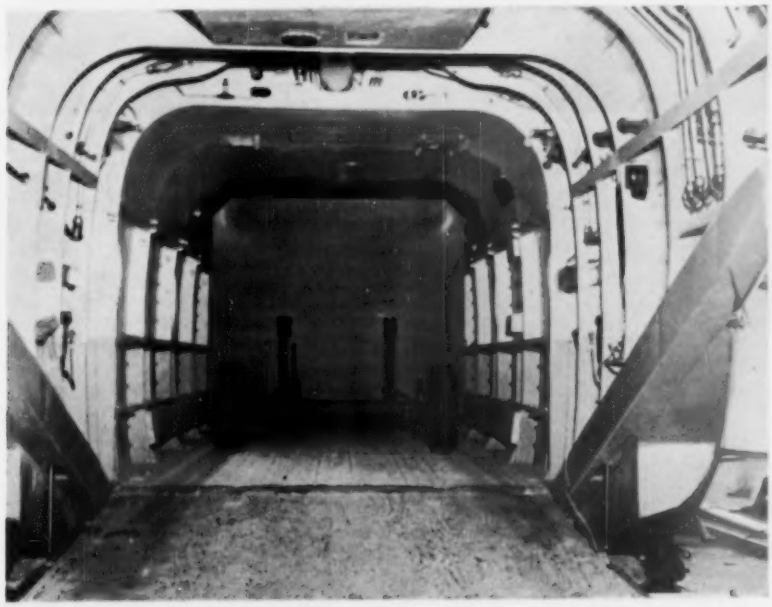
Atlantic Research has concentrated primarily on solid propellant work in the past. This contract carries the company into a new area, although it has had some experience in the development of slurry-type rocket propellants. Company says it also has done some research aimed at increasing the solids loading of composite solid propellants, and this will apply to the ramjet work.

Ramjet slurry fuel research and development work will be done at Atlantic Research laboratories in Alexandria, Va. A major portion of combustion testing will be subcontracted to Marquardt Corp.

Pershing Components Loaded on Vertol YHC-1B

Transporter-erector-launcher for the Pershing missile system is loaded through the rear ramp of a Vertol YHC-1B Chinook mockup. Components were designed for helicopter transport to give missile battlefield mobility.

First stage of Pershing missile enters 1,600 cu. ft. cabin through rear-loading ramp (above). Fire-control hut for the missile enters cabin (below). Chinook cabin is 30 ft. long, 6.5 ft. high, 7.5 ft. wide.



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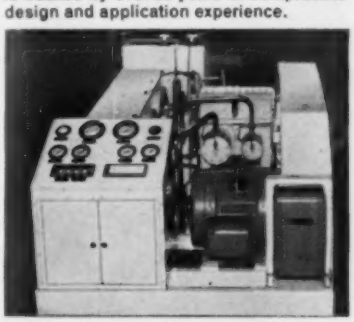

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An advanced tactical early warning radar, Sperry's extended-range MPS-21 is scheduled for adoption by the Marine Corps. The air-transportable system sets up in less than eight hours to provide concise information for control of combat interceptors.

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In all, the MPS-21 is an advanced example of U. S. capability today in the critical area of tactical early warning.

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ARMY version of Sikorsky S-56 operated by FAA spends 10 min. on the ground at Westchester County Airport to simulate passenger off-loading stop in actual IFR operation. A second stop in the helicopter's daily shuttle between Atlantic City and Bridgeport takes place at Idlewild.

FAA Tests Helicopter IFR Requirements

By David H. Hoffman

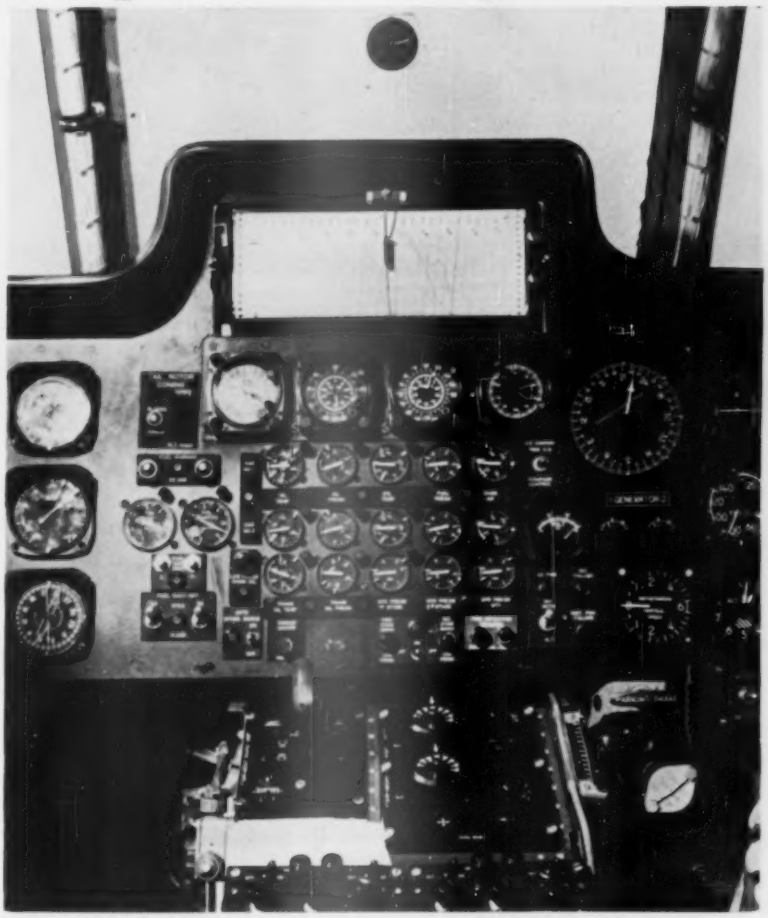
Atlantic City, N. J.—Establishment of rules and control procedures that will give the helicopter all-weather capability is the goal of a five-year flight test program now unfolding at Federal Aviation Agency's research center here.

Today commercial helicopters may operate only under visual flight rule (VFR) conditions. But both the FAA and the helicopter airlines are aware that costly, turbine-powered rotorcraft of tomorrow will realize their economic potential only if all-weather shuttle service between big metropolitan airports can be provided.

To frame ground rules for such service, FAA launched its multi-phase Helicopter Operations Program, designing it to evolve through 1964. Phase I of the program was an evaluation of the Decca Mk.8 navigation system, which FAA found unsatisfactory as a primary IFR aid for helicopters (AW Feb. 22, p. 43).

Now in its seventh month, Phase II of the program largely is concerned with problems encountered by the helicopter when it mingles, vertically and horizontally, with fixed-wing aircraft under IFR conditions. The FAA, to illustrate, is searching for answers to these among many other key questions:

- **What obstacle clearance** should the helicopter's minimum en route altitude provide? Because rotorcraft often circumnavigate surface hazards while fixed-wing aircraft overfly them, a third dimensional aspect has been added to low-level map-making. Airway surveys and cockpit instrumentation therefore must be more precise.
- **Can a helicopter control system** be



COCKPIT of Sikorsky S-56 (Army H-37) used in FAA's helicopter IFR test program shows Decca flight log mounted over engine instrument panel. Deccometers directly under scroll are used to cross-check position indicated by stylus with output of three Decca transmitters located in the New York area.

The A3J adds new flexibility to America's sea-air power

Small enough to land on a carrier deck, yet potent enough to pack a heavyweight punch, the Navy's A3J Vigilante is the world's most versatile Mach 2 airplane.

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The A3J—a compact, businesslike, hard working airplane with unlimited talents—was designed and built by the Columbus Division of North American Aviation.

THE COLUMBUS DIVISION OF NORTH AMERICAN AVIATION, INC.

Columbus, Ohio

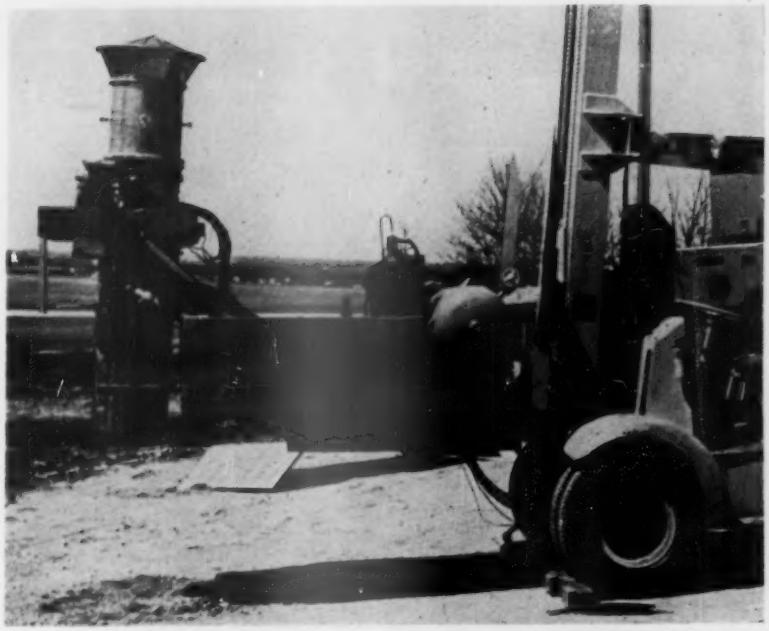
predicated on the helicopter's ability to hover? Cost-conscious commercial operators claim that the hovering of a heavily loaded helicopter imposes a maintenance burden. To avoid pulling excess power from engines and upsetting blade adjustment they contend that short takeoff rolls are a necessity.

• **How close to a ramp** or runway can a helicopter landing pad be built? Will the vortices generated by jet engines affect the helicopter's takeoff performance, or will rotor downwash damage the control surfaces of a parked aircraft? At what distances?

• **What type of approach lighting** at a heliport will best portray altitude and azimuth to the pilot of a landing helicopter? Will such lighting or the lighting on the landing pad itself confuse the pilots of fixed-wing aircraft as they break out of low ceilings at the airport?

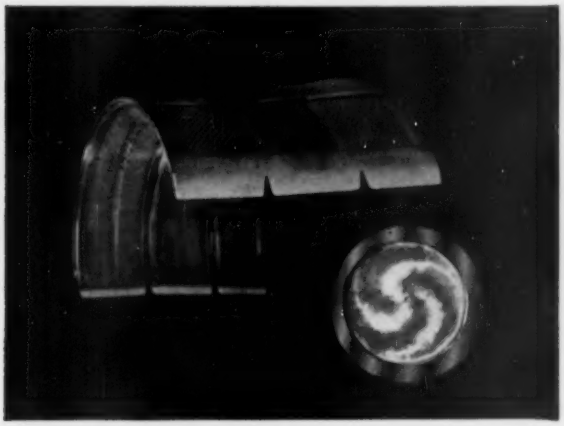
Answers to these questions still are not in. But at FAA's National Aviation Facilities Experimental Center here, task managers of the research program are assimilating data already produced by more than 300 hr. of test flying helicopters under the hood or through actual weather.

Each weekday morning since February, a Sikorsky S-56 (Army H-37) helicopter has left the Bridgeport, Conn., Airport bound for Atlantic City along



J85 Tested for VTOL Application

Special test rig was built at Wright Air Development Division to demonstrate the feasibility of using General Electric's J85 turbojet engine as a powerplant for direct-lift VTOL aircraft. Trunnion-mounted on a forklift truck, the engine was successfully started and run at military power in both vertical and horizontal positions; J85 continued to operate satisfactorily during transition from one position to the other.



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a 139-mi. course that includes stops at Westchester County Airport and at Idlewild. Each afternoon, the S-56 has returned to Bridgeport via the same route.

At the controls of Brad 18, the test ship's call-sign, are two pilots furnished either by the Marine Corps or the Army.

An FAA pilot-observer rides between them on the ladder leading up to the cockpit from the 31,000 lb. helicopter's cargo compartment.

IFR Flight Plan

Regardless of the weather, Brad 18 follows an IFR or SIFR (simulated IFR) flight plan through the traffic-saturated metropolitan New York area. When ceilings drop below 500 ft. or when visibility lowers to less than one mile, the helicopter overflies Westchester County and Idlewild. No-wind course speed of 85 kt. is varied to make good flight plan time between 18 check points spaced an average 7 mi. apart along its winding route.

Basic navigation aid throughout the flight is Decca—not because the FAA necessarily approves of it, but because Decca is readily available and represents a typical hyperbolic system with pictorial display. In the cockpit, the helicopter's course is portrayed as a dotted line unfolding on a 9.5 in. Decca scroll. Holding patterns, within which the S-56 can maneuver at will, are drawn in. Flying over water more often than not, the course criss-crosses the principal omni and LF airways leading into New York.

On the seventh floor of Idlewild's control tower next to the darkened radar room that houses approach and departure control, FAA has set up a Helicopter Control Center to monitor Brad 18's progress. The center picks up the flight on 123.3 mc. when it leaves Bridgeport tower frequency, then changes the helicopter over to Westchester Approach Control at Stamford intersection.

Separate Center

This process of passing Brad 18 back and forth between tower, approach and departure controls is repeated at Idlewild and at Atlantic City. FAA wants to know whether a separate center for helicopters can be substituted for Air Traffic Control in the absence of other, more sweeping changes in its over-all IFR system.

After Idlewild radar identifies the slowly moving helicopter's blip, Brad 18 is given just half the standard, 3-mi. lateral separation afforded other aircraft in the area. This holds true, regardless of forward visibility, for as long as the helicopter pilots have visual contact with the ground.

To maintain VHF voice communica-

ations with the S-56, which normally files for 500 or 1,000 ft. MSL, FAA has had to install relay transmitters in New Jersey and Connecticut—illustrating still another problem peculiar to low level, rotorcraft operation. If VHF or UHF is to be used for command communication within a helicopter control system, line-of-sight limitations may force FAA to blanket relatively large areas with relay stations.

Ultimately, the Brad 18 test route will be expanded to include flights into or over every airport in the New York City control zone. Cameras mounted in the Helicopter Control Center at Idlewild will photograph radar flight tracks and record drift-offs. These, in turn, will be cross-checked with Decca flight logs to determine over-all accuracy of the pictorial display type system in an operational environment.

With traffic simulators at NAFEC, the program then will multiply flight frequencies over the New York routes, imitating the forecast impact of vastly expanded helicopter operation in the area.

Thus the New York control zone —with its high density traffic, multiple airports and noise abatement problems —is serving as a test bed for future rotorcraft navigation and traffic control systems, cockpit instrumentation, engine and airframes and pilot standards.

Initial Recommendations

Already these positive recommendation have emerged from the program:

- **Minimum en route altitude** (MEA) for helicopters should be 500 ft. below that specified for fixed-wing aircraft along a given airway segment.
- **Standard helicopter holding** pattern should be one mile long. A two mile pattern, by contrast, is standard for fixed-wing aircraft.
- **Aeronautical terminology** should be clarified to make it meaningful to rotorcraft. For example, is "light to moderate turbulence" the same for helicopters and fixed-wing aircraft?
- **Helicopter letdown minimums** of 300 ft. and one mile are entirely safe for test program purposes.

Task Manager Frederick Freeman, Deputy Manager Irwin Kersey and Air Traffic Control Specialist L. C. Moore —the directors of the Helicopter Operations Program—realize that the helicopter should move in and out of a terminal at relatively low altitudes for maximum control efficiency. For when low-speed rotorcraft are mixed with fixed-wing aircraft, especially at the levels from 1,000 through 3,000 ft., traffic flow along ILS courses and arrival and departure routes is disrupted.

On the other hand, if unchanneled helicopter traffic is allowed to saturate lower altitudes around a terminal, fixed-

Anti-personnel Mine Detector AN/PRS-3 (XR-12) designed and built for the Corps of Engineers by Texas Instruments.

TI IN MILITARY DETECTION SYSTEMS

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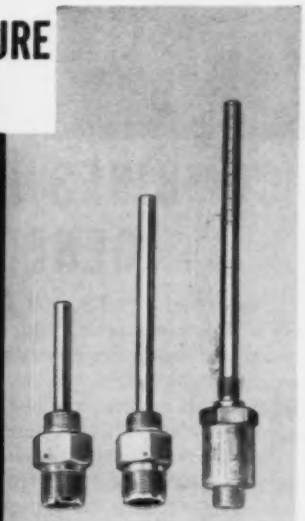

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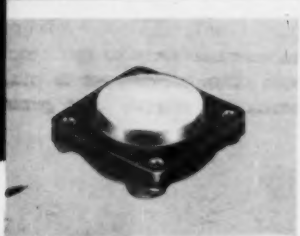

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TF-30	JTF-11	■	■	□	□	□	□
—	ARB-163	■	■	■	□	□	□
—	ARB-963	■	■	■	□	□	□
R. R. Avon	RA-29	■	■	■	■	□	□
J-52	JT-8	■	■	■	■	□	□
J-57	JT-3	■	■	■	■	□	□
TF-33	JT-3D	■	■	■	■	□	□
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COMBINES ELECTRIC STARTING AND 400-CYCLE GENERATING IN A SINGLE PACKAGE

The new Sundstrand Starter-Drive eliminates the need for a separate starter, and offers aircraft manufacturers and operators substantial savings in cost and weight. Light weight, compact size, and QAD mounting facilitate retrofit on a wide variety of military and commercial aircraft (see chart above).

The Starter-Drive is basically a standard aircraft a-c generator and a Sundstrand hydrostatic transmission. For starting, the generator functions as an electric motor (aircraft generators are designed to permit this). Driven by 400-cycle ground power the generator accelerates freely to synchronous speed. The transmission then takes over to multiply motor torque and crank the engine. For generating, the functions are reversed and the transmission provides constant output speed to the generator.

This new Starter-Drive requires only one engine pad, simplifies ground support equipment, permits engine motoring, and provides electric cross starting from an idling engine. It eliminates power interruption when changing from external power to the aircraft system and provides full overload capacity from engine idle to maximum speed. Automatic engine torque limiting and low hydraulic pressure at cruise assure long life and infrequent maintenance.

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wing aircraft would be forced to fly steep gradient approach paths to maintain safe separation.

Two S-56s now are being used in the program, both on loan to FAA from the Army and the Marine Corps. These two services also lend pilots and flight engineers, but FAA pays all of their extra expenses during the 22 days that each participates in the experiment. Helicopter maintenance is performed by Sikorsky.

After a 20-hr. course of instruction, which includes about 10 hr. of transition in an FAA helicopter, the pilots are given three trips in which they observe a checked out crew flying the test route. The new pilots then are upgraded through the copilot's seat to plane commander status.

Negotiations now under way may lead to FAA's flying a prototype Vertol 107 twin-turbine helicopter in the program. With this higher speed rotorcraft, FAA feels that it could come close to simulating the character of future helicopter airline operations.

If a 107 is acquired, FAA will ask the three major helicopter airlines in the United States—New York Airways, Chicago Helicopter Airways and Los Angeles Airways—to furnish volunteer pilots. Pilots from British European Airways and Sabena Belgian World Airlines already have offered to participate in the test.

PRODUCTION BRIEFING

Beech Aircraft Corp., Wichita, Kan., will develop high performance in-flight refueling systems for the Navy under $1 million contract. The ram air-driven system, capable of pumping 400 gpm. at 50,000 ft. and 400 kt., employs a 40-ft. flexible hose and drogue. Beech will build an experimental unit and three prototypes of the system designed to adapt to several Navy fighter and attack aircraft.

Grumman Aircraft's subsidiary, Aerobuilt Bodies, Athens, N. Y., will produce mobile pilot ready-rooms for the Navy under $850,000 contract. A ready-room facility will consist of two 40-ft. trailer units. One trailer will serve as a dressing room and storage area for full pressure flight suits; a connecting trailer is a briefing and alert room.

Republic Aviation, Farmingdale, N. Y., will continue work on the AN/USD-4 short range surveillance drone under $8.5 million Army contract.

Sierracin Corp., Burbank, Calif., will produce its plastic laminate windshields for production models of the North American T-39 Sabreliner. The windshield prevents fogging and icing by

CENTAUR (A United States Space Vehicle) will report back through TI-built FM/FM telemetry.

TI TELEMETRY IN MISSILE SYSTEMS

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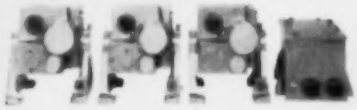
LMED's CAT family includes:

Tomcat... now in production for Lockheed's Missile Systems Division and the Air Force's Ballistic Missile Division... designed for accuracy to ½ degree or better.



Wildcat... also under development for Lockheed and the Air Force... with 360° vision for sharply varying altitudes.

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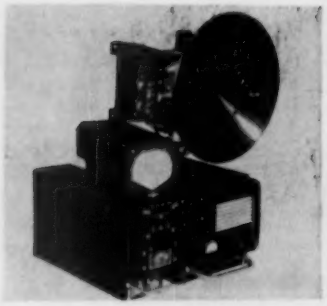


Lightplane Radar

Lightweight weather radar, for business aircraft, weighs less than 50 lb. and provides operating range out to 150 mi. Developed by Collins Radio Co., new WP-103 radar operates at X-band, consumes only 320 watts as a result of widespread use of transistors. Radar can be obtained with 12, 18 or 30-in.-diameter stabilized antenna. Panel indicator has a 4½-in.-square face and is available with bright-tube display on optional equipment. New Collins radar will be available in production early next year.

---

means of an electric conductive coating called Sierracote. The windshields also will be installed in the Vertol YHC-1B Army transport helicopter.

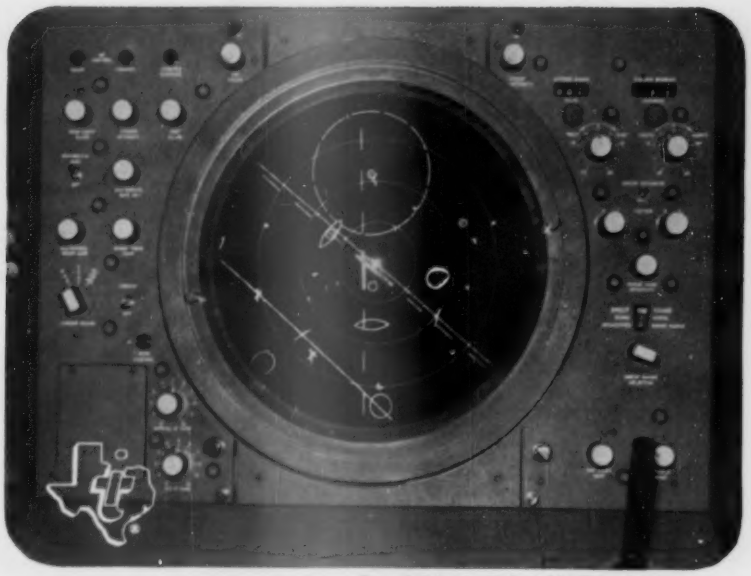
Beech Aircraft Corp., Wichita, Kan., will continue production of the Model 1025 (Navy KDB-1) missile target under $3 million Army contract. Deliveries under the new order will begin in February, 1961.

General Electric's Large Jet Engine Dept., Cincinnati, Ohio, will produce J79 turbojet engines for 1961 delivery under $21 million Air Materiel Command contract. The contract covers powerplants for the Navy's McDonnell F4H-1 fighter and North American A3J attack aircraft.

Goodyear Aircraft Corp., Akron, Ohio, will produce nose radomes for Navy A3D attack aircraft being modified to test the Eagle air-to-air missiles. The Douglas aircraft will be converted for the Eagle missile development program. Douglas also will build the Missileer, the subsonic jet designed to carry the Eagle.

Robertshaw-Fulton's Aeronautical and Instrument Division, Anaheim, Calif., will produce six helium regulators for the Martin Titan ICBM under $1.5 million contract. The six models of differential pressure regulators control the pressure in the first- and second-stage oxidizer and fuel tanks of the Titan.

Westinghouse Electric Corp., Pittsburgh, Pa., will supply nuclear reactor



Ground clutter is eliminated by TI moving target indicator shown with video map at 20-mile range.

TI IN HEAVY RADAR SYSTEMS

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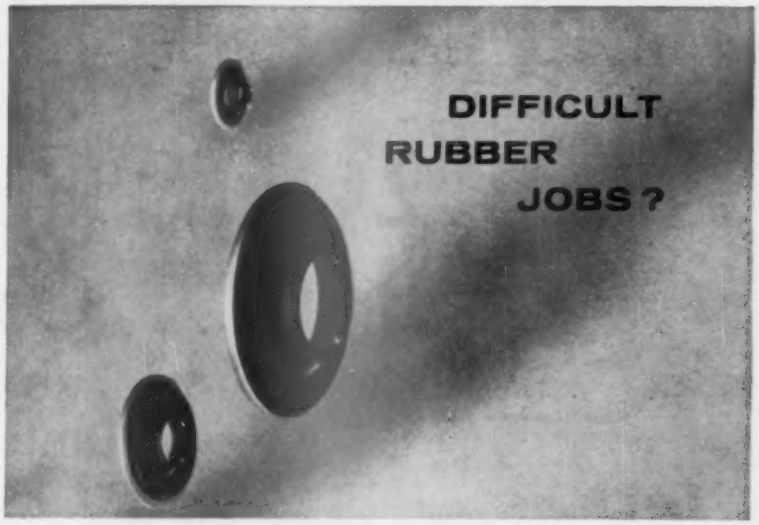

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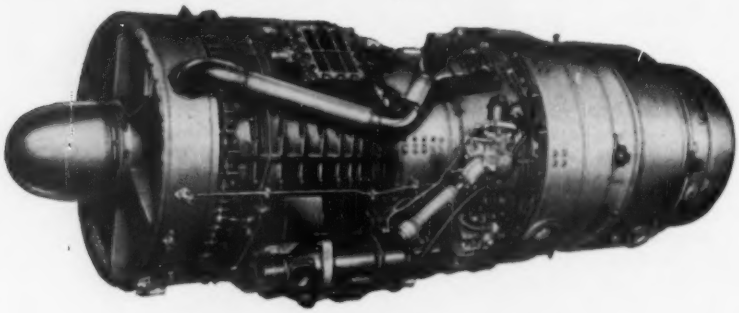

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compartment components for fleet ballistic missile submarines under $36 million Navy contract. Components include reactor vessels, control drives, coolant pumps and steam generators.

Avco Corp. has formed a new Industrial Products Subdivision of its Research and Advanced Development Division to market products in the fields of high temperature technology and environmental simulation. Avco also has changed the name of its Crosley Division to Avco Electronics and Ordnance Division.

Douglas Aircraft Co., Tulsa, Okla., will overhaul and modify 78 Boeing B-50 aircraft under Air Materiel Command contract. Included in the 78 aircraft are KB, WB and RB models, but the majority of the aircraft are KB-50 tanker aircraft.

Bell Aerosystems Co., Buffalo, N. Y., will provide miniature accelerometers for the guidance system of the Douglas Skybolt air-to-ground ballistic missile. Bell will build the accelerometers for the Nortronics Division of Northrop Corp., guidance system subcontractor on the Skybolt.

Cessna Aircraft Co., Wichita, Kan., will continue production of stabilizer, fin and rudder assemblies for the Republic F-105 under $3.8 million contract from Republic.

Goodrich Aviation Products, Akron, Ohio, will supply electric propeller deicing systems for Piper UO-1, Navy designated Aztec. The system weighs 10 lb. and draws 9 to 11 amp. of power.

Springs for ICBMs

Coil compression springs will be used to stabilize intercontinental ballistic missiles on launch pads during nuclear bombardment. The two springs shown, plus a third inner spring, are nested concentrically, beneath the missile. Outer coil, of 3-in. steel, measures 49 in. high x 22 in. outside diameter. The maker is Union Spring Co., New Kensington, Pa.

U. S. Navy P5M-2 antisubmarine patrol seaplane, produced by Martin—equipped with TI-built AN/APS-80 surface search radar, AN/APA-125A radar indicator, AN/ASQ-8 magnetic anomaly detector and TD-239A intervalometer.

TI RADAR & MAGNETICS IN ANTISUBMARINE SYSTEMS

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PROBLEMATICAL RECREATIONS 31

Two candles have equal lengths. One is consumed uniformly in four hours, the other in five hours. If they are lighted at the same time, when will one be three times as long as the other?

—California Engineer

Some of the products of our Electronic Equipments Division, including air navigation systems, are going to be made in Germany by Litton's Hellige & Co. operation, located in Freiburg-im-Breisgau in southwestern Germany.

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Dept. AW-9B, Akron, Ohio

Westland Builds Helicopters for British Army

Skid landing gear is new modification on Westland Skeeter Mk. 12 helicopter for Britain's Army Air Corps (above). Craft shown is standard production type weighing 2,200 lb. and powered by 250-hp. DH Gipsy Major piston engine. Rotor diameter is 32 ft. Westland Wasp (below), one of pre-production order for Britain's Army aviation units, is powered by a de-rated Blackburn Nimbus A.129 free-turbine engine designed for 885 shp., and running at 650 shp. Helicopter shown (XP 167) is fully instrumented test aircraft for performance and handling trials; strain gages have been fitted for these tests. Rotor diameter is almost the same as the Skeeter's—32 ft. 3 in.—but Wasp weighs 5,000 lb. Naval versions can carry torpedoes or mines; Army craft carry wire-guided missiles.

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BFG hose for fuel, oil, and coolant lines is ruggedly built with multiple braids for high strength and burst resistance. Type H-100 all purpose type, sizes ¼" through 4" I.D. Type A0-19 fire resistant type for fuel and oil lines ahead of engine fire wall, sizes ¼" through 2" I. D. For fuel, De-Icer, or instrument line hose check B.F.Goodrich.

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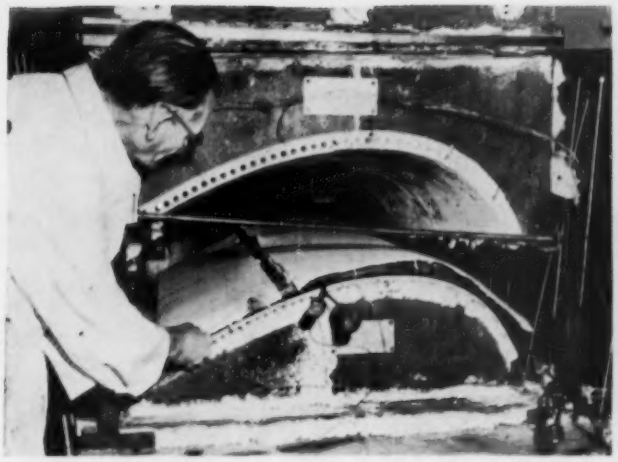
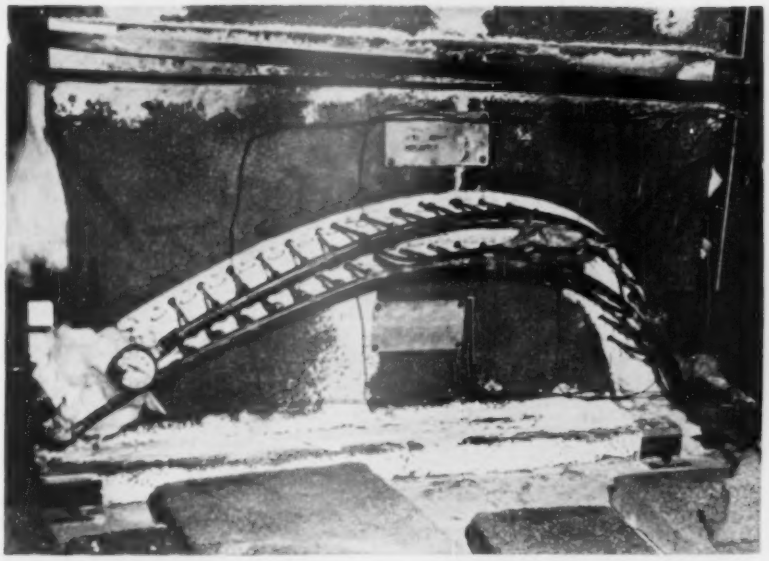


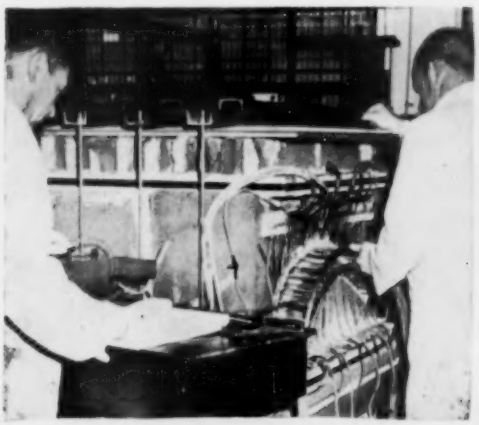
Avcomb core and outer panels are placed between upper and lower platens which contain electrical heating elements needed for brazing. Upper and lower platens are locked into position and surround the honeycomb package with a vacuum.

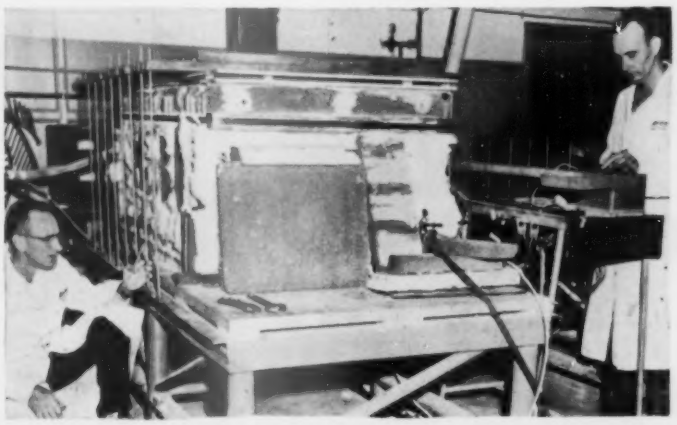
Avco Develops Tool for Brazing Steel Honeycomb

Stainless steel honeycomb panels for the North American B-70 bomber are brazed, conditioned and aged in a single fabricating tool at the Avco Corp.'s Nashville facility. The production technique, called Avcoramic, incorporates ceramic brazing platens which contain heating elements and cooling ducts. The ceramic platens are closely machined and serve as contact forms for the honeycomb sandwich material. To assure close brazing contact, external pressure is applied to the forms and a vacuum is maintained within the envelope. The ceramic platens are then heated electrically to brazing temperature for a short time period. Rapid cooling is achieved by passing cold air through the ducts in the ceramic forms. The platens are then reheated, aging the honeycomb for maximum strength. Avco says that brazing, conditioning and aging stainless steel honeycomb in a single production tool provides sufficient cost reduction to make the material economical in new applications.



Ceramic material then is heated electrically to proper brazing temperature (above). Next, the platens and the Avcomb stainless steel sandwich are cooled rapidly by air forced through the holes in the ceramic platens (lower left). To achieve maximum strength, the panels then are aged electrically by re-heating through the platens.





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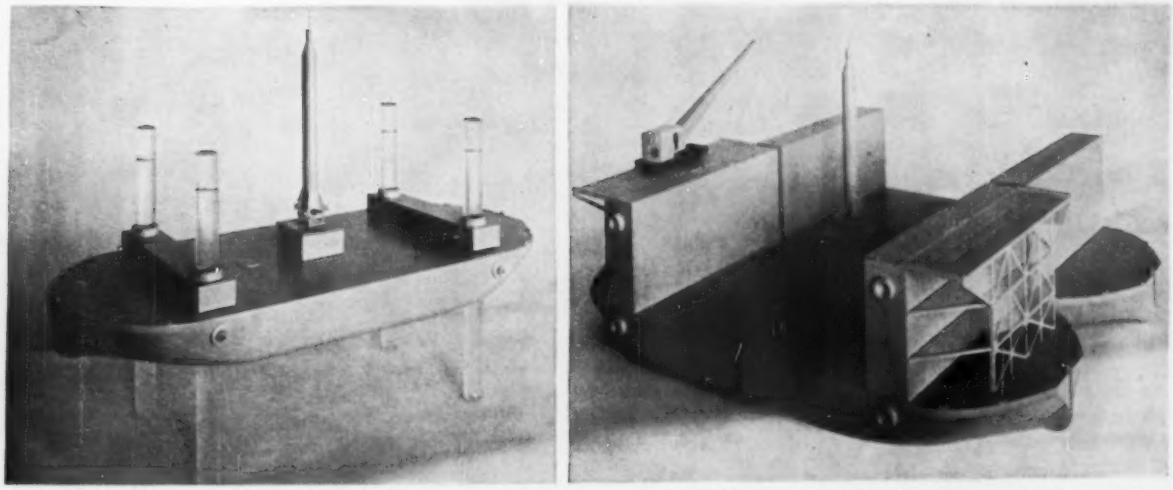
Side-Looking Radar Installed on Grumman Mohawk

Grumman Mohawk turboprop observation plane for U. S. Army has been fitted with SLAR gear (side-looking airborne radar) carried in pod slung below the belly. System provides Army with radar photographic maps on 4 in. x 5 in. cut film or on 70 mm. strip film; inflight processor enables an observer to see developed film shortly after exposure. In addition to SLAR, all production Mohawks (Grumman will build 77 for Army) will be equipped with a high resolution optical photographic system as basic equipment.

Mohawk AO-1 is powered by two Lycoming T-53-L engines delivering 1,005 eshp. Wing span measures 42 ft., over-all length is 41 ft. Note wing root mounted flare pod (above). Pods, mounted on both sides, hold 52 flares which are ejected upward by cockpit control. Various access panels are shown below in opened position.



SINGLE UNIT Modock could be used as an offshore launcher for intercontinental ballistic missiles. Model depicts an ICBM mounted on a flame deflector. At right, two docks have been welded together to give a larger working and launch area. Crane has 30 tons capacity.

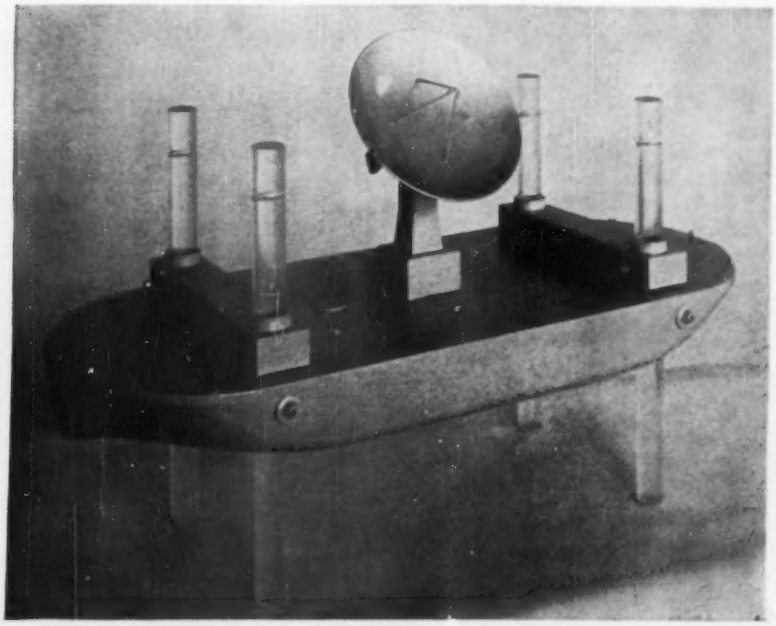
Docks Proposed as Offshore Launch Sites

By William S. Reed

Los Angeles—Surplus floating drydocks, in mothballs since the end of World War II, are being proposed to various government agencies and industry segments as sites for tracking stations, mobile missile launchers and, eventually, as pads for firing nuclear ramjet engines. Proponents of the idea say this will simplify problems of site acquisition, construction and support and, in the case of the nuclear engine, surrounding-area contamination.

Proposals outlining conversion of 28 advanced-base cruiser drydocks to missile-age uses have been detailed by S. Kenneth Johnson, partner in the architect and engineering firm of Daniel, Mann, Johnson and Mendenhall to:

- **Air Research** and Development Command.
- **National Aeronautics** and Space Administration.
- **Air Force** Ballistic Missile Division.
- **Convair Division** of General Dynamics Corp.
- **Lockheed Aircraft Corp.**
- **Boeing Airplane Co.**
- **Other industry members.**



TRACKING STATION application of the Modock concept shows the positioning of the hydraulically operated DeLong Texas Tower legs.

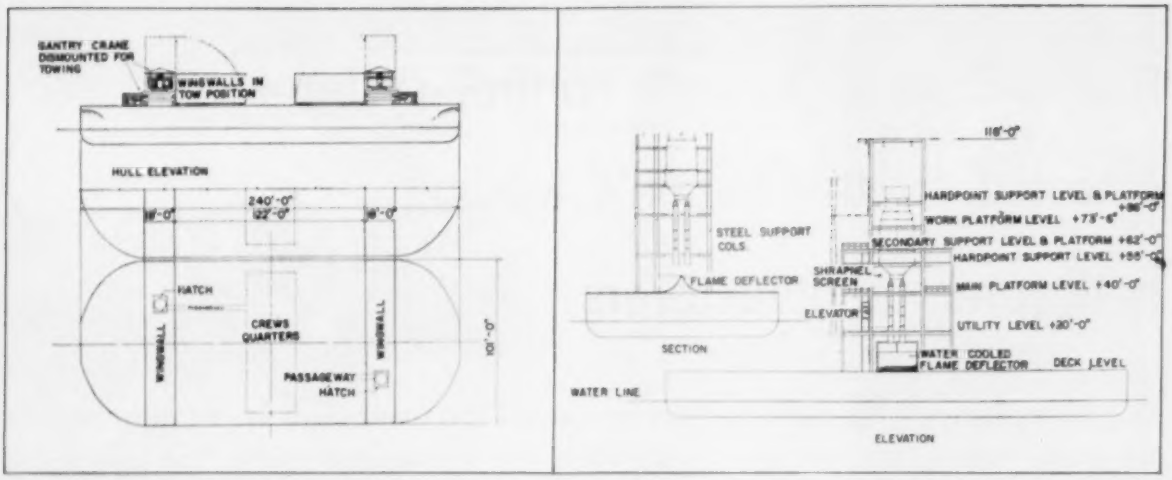
Land Sites

Lockheed's recent proposal to Ballistic Missile Division on establishing a tracking site in Africa as part of the Midas and Samos network (AW Aug. 22, p. 29) specifies that the converted drydocks, dubbed Modock by the company, will be used. Efforts to acquire land sites in Africa have been thwarted by the unstable political situation, compounded by the high cost of building access roads, moving in equipment, and supporting construction and operating personnel. According to Johnson's proposal, the drydocks can be refitted, instrumentation and electronic gear installed near the contractor's facility, and the complete Modock towed to the offshore site.

Once positioned in waters less than 150 ft. in depth, DeLong Texas Tower legs can be hydraulically extended to the sea floor raising the Modock clear of the ocean to ensure complete stability.

Each of the drydocks measures 240 ft. in length, has a beam of 101 ft. and a buoyancy of about 9,000 tons. Decks are ½ in. steel reinforced by very heavy internal trusses to support the weight of an Essex-class cruiser. Seven of the docks, welded beam-to-beam, can support an 80,000 ton vessel.

Estimated cost of refitting one dock



DRAWING shows the advanced base cruiser drydocks as they appear in mothballs. During flooding, all but the top five feet of the wingwalls are under water, necessitating crew entrance through hatch. Eight of the docks were welded together to accommodate an Essex class cruiser. Total of 28 are in Navy surplus shipyards.

as a tracking site is $1.2 million plus instrumentation, electronics and antennas.

Advantages claimed by Daniel, Mann, Johnson and Mendenhall include the following:

• **Complete installation** and checkout of equipment can be done in the U.S., eliminating the necessity of maintaining large numbers of technical personnel abroad. Modock then could be towed at speeds to 10 kt.

• **Resupply** can be accomplished by sea routes, eliminating the need for building access roads or using aerial delivery.

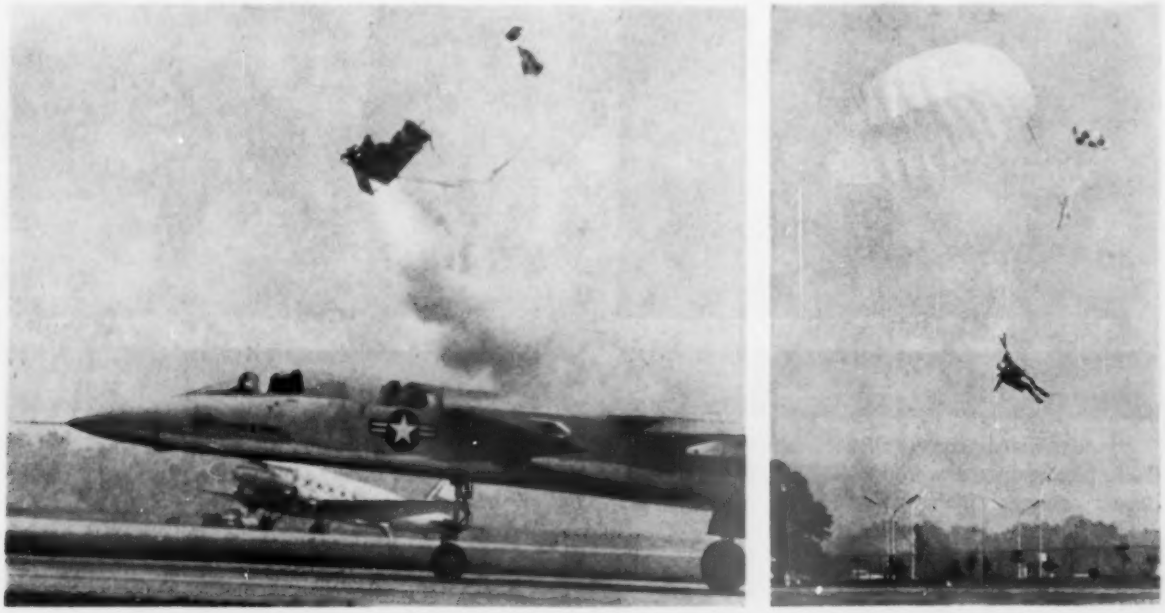
• **Self sufficiency** of each unit includes two 350 kva. diesel driven generators and complete living quarters.

• **Negotiations** for offshore anchorage rights probably will be easier to obtain. Interference with local politics could be kept to a minimum as compared with the sometimes difficult situations experienced with land sites. In some cases it may be possible to establish sites outside territorial limits if waters are not too deep.

• **Modocks** could be lowered into the water and towed to other sites when their purpose is served, or be returned to the U.S.

Modock adaptability as launch sites for intercontinental ballistic missiles such as Atlas has also been studied by the company. In addition to the same advantages claimed for the tracking site installations, unlimited water is available for cooling the flame bucket and large capacity pumps are integral with the drydocks.

An alternate method of handling the exhaust consists of cutting a 12-ft.-



North American Demonstrates A3J Rocket Ejection Seat

Anthropomorphic dummy is ejected from the rear cockpit of the North American A3J Navy attack aircraft rolling at 100 kt. The rocket propellant seat reaches a height of 135 ft. prior to seat separation and automatic parachute deployment. The rocket ejection system is incorporated in North American's A3J and T2J jet trainer.

Barber-Colman aircraft control systems selected by the nation's leading helicopter manufacturers

Quality products go together — that is why you will find that today's newest helicopters use Barber-Colman temperature control systems and positioning systems. The leading craft shown here — by Bell, Kaman, Sikorsky, Vertol — use Barber-Colman control systems either for heater cycling, air conditioning, or high-speed remote positioning. Barber-Colman systems also find wide usage on other types of flight vehicles and ground support equipment. For assistance on your control problems, consult the Barber-Colman sales engineering office nearest you: Baltimore, Boston, Fort Worth, Los Angeles, Montreal, New York, Rockford, Seattle.

BELL HU-1 IROQUOIS

Turbine-powered Army utility helicopter equipped with Barber-Colman heater cycling system.

KAMAN HUK-1

Navy utility helicopter equipped with Barber-Colman heater cycling system.

see facing page for other helicopters equipped with Barber-Colman control systems

SIKORSKY S-58

Commercial passenger helicopter
uses Barber-Colman
heater cycling system.

VERTOL YHC-1A

Army transport helicopter equipped with
Barber-Colman fail-safe high-speed remote
positioning system for engine throttle control.

SIKORSKY S-61L

All-weather commercial helicopter
equipped with Barber-Colman
air conditioning control system.

VERTOL 44

Commercial transport helicopter equipped with
Barber-Colman heater cycling system.

BARBER-COLMAN COMPANY

DEPT. I, 1422 ROCK STREET, ROCKFORD, ILLINOIS

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TRANDUCERS AND THERMOSTATS, SPECIAL GROUND TEST EQUIPMENT

THE MARK OF QUALITY

BARBER COLMAN

diameter sleeve in the deck of the Modock through the hull and allowing the exhaust to impinge on the sea.

Coffin-type launchers could be built on the deck with ample room for installation of electronic and support gear. Adequate storage also is available for liquid oxygen and fuel. Company estimates the conversion cost of a launch site at about $1.2 million.

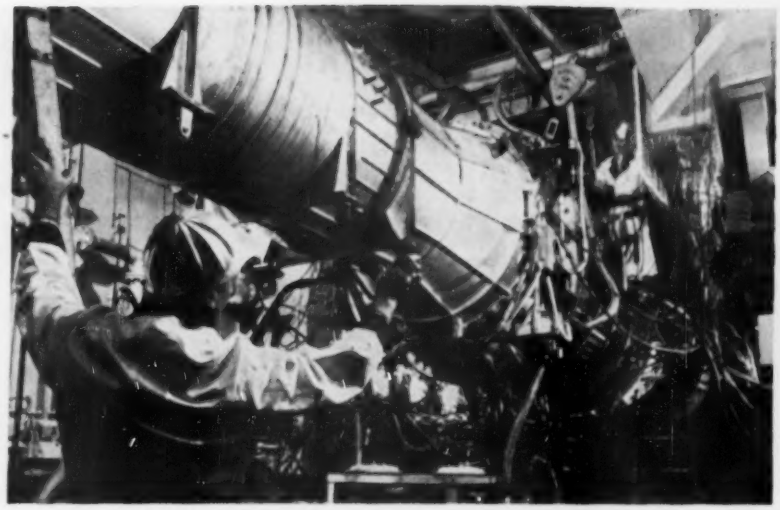
The Modock concept also is suited for testing large boosters, such as the 1-million-lb.-thrust Centaur, says Johnson. As a test site, one dock could be used to house the test stand and additional units tied alongside could house personnel and test equipment.

Prior to firing, support docks could be withdrawn to a safe distance to observe, eliminating the need for a heavy blockhouse. Because the weight of the Modock is in excess of 20 million lb., even the thrust of a 1 million lb. engine would add only a small increment to the over-all weight of the dock. Again, ample sea water, supplied by high capacity pumps, would be available for flame bucket cooling.

Still another use proposed for Modock is as a site for testing and launching nuclear ramjet vehicles, such as the proposed Slam (supersonic low altitude missile). An obvious advantage, the company claims, is that test sites and launchers could be maneuvered anywhere to minimize radiation hazards.

Should a nuclear accident occur, contaminating the vessel, abundant sea water is available for cleaning the surface using well-established Navy techniques. If the disaster was such that the vessel became not merely contaminated but radioactive, it could either be scuttled on the spot or towed to deep water and sunk. Compared with the cost of decontaminating or fencing off a land site, Modock offers a simple solution to this problem.

Estimated cost of converting three



J93 Gets Ramjet Pressure Tests

General Electric J93 turbojet engine is encased for pressure and temperature tests at the company's ramjet test facility at Cincinnati, Ohio. High pressure, high temperature ram air is fed to the engine from a compressor unit. Engine is for the North American Mach 3 B-70 bomber.

BOUNDARY LAYER BREAKTHROUGH

New BLC-130 takes off or lands in five times its own length

such units, installing an appropriate flame bucket and assembling them in a South Pacific location is $1.2 million.

Daniel, Mann, Johnson and Mendenhall put the first Modock proposal on paper Dec. 1, 1959. The idea occurred to Johnson as a result of his being architect in charge of design and construction of floating drydocks at a shipyard during World War II. Altogether, the Navy built 58 of these advanced-base drydocks, 29 to accommodate battleships and a like number for Essex-size cruisers.

Of the total number built, all but one now are in mothballs at various shipyards around the U. S. One cruiser-size drydock was accidentally sunk during World War II. The Navy declared surplus the 28 remaining cruiser-size docks, each with a lifting capacity of about 18 million lb. Built at a cost of $5 million during the war, 10 of the larger-capacity units were put beam-to-beam for battleship drydocking—seven smaller units were used for cruisers.

Each of the mobile docks is a completely self-contained unit with crew quarters for 20 men, two 350-kva. generators, messing facilities, extra large capacity water pumps, water supply, fuel storage tanks and machine shop areas. In practice, they were to be towed alongside each other, welded at special joints and the ballast tanks flooded until only five feet of the wingwall remained above the water. A ship then was maneuvered into position, blocked and supported, and the water then pumped out of the dock. Even while it was flooded, crew quarters were accessible through a hatch and companion way, located in the wingwall.

Under way, the drydocks can be towed individually at a speed to 10 kt., but are relatively immobile when welded into units of two or more.

Wing Mated to Sabena Caravelle VI

Wing is mated to the fuselage of one of four Sud Caravelle VI twin jet transports ordered by Sabena Belgian World Airlines. Plane will be built in the U. S. by Douglas Aircraft (AW Aug. 8, p. 53). Douglas demonstrator currently is at Edwards AFB, Calif., for installation of General Electric CJ805-23 aft fan engines, replacing its Rolls-Royce Avons.

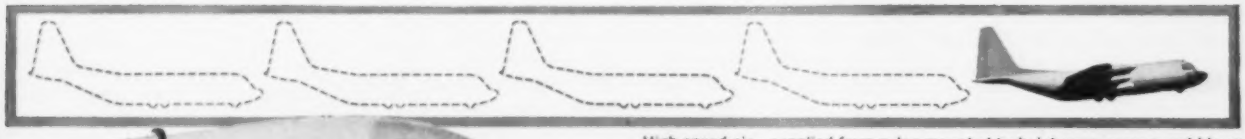
Imagine a 50-ton Hercules airfreighter lifting off in just 500 feet, from a standing start on an unprepared field. Or picture the big prop-jet stopping after touchdown in 520 feet. This performance of Lockheed's Boundary Layer Control C-130, at mid-point of a 2000-mile round trip mission, is truly remarkable. But its significance goes far beyond the spectacle itself.

The BLC-130 brings true STOL capability to Air Force support missions. Whether it has to rush 92 combat troops to a spreading brush-fire fight, or airlift 18 tons of food to some remote hunger spot, the huge airlifter will be able to deliver its payload closer to the action than ever before possible.

A test bed BLC-130 has completed advanced flight tests, clearly illustrating the feasibility of boundary layer control on big planes.

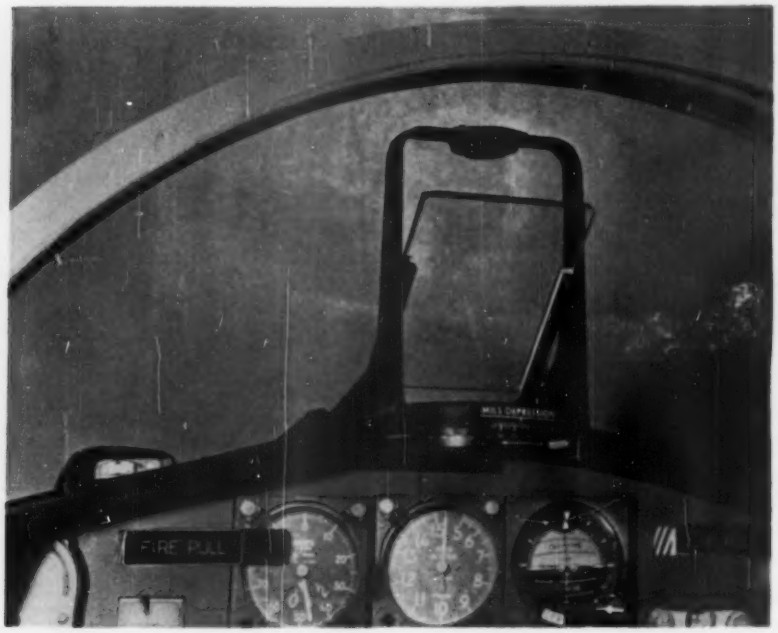
LOCKHEED

GEORGIA DIVISION MARIETTA, GEORGIA



High speed air—supplied from pylon-mounted turbojet compressors and blown over flaps, ailerons, elevator, and rudder—causes the airstream to hug the surfaces instead of being separated from them. The energization of this boundary layer of air gives the BLC-130 its extraordinarily high lift.

NEW AVIATION PRODUCTS



Optical Aircraft Sight Minimizes Panel Interference

Adjustable optical sight is designed to minimize obstruction of pilot's forward visual field. The 2.5 lb. sight, developed by the Northrop Corp., may incorporate stodiametric ranging or weapon system information collimated along with the reticle pattern. The sight is shown as it would be installed on the Northrop N-156F fighter.

High Temperature Bearing

Precision ball bearings for airborne applications will operate in excess of 1,000 hr. at 575F without conventional lubrication. The bearing has been qualified on synchros, motors, tach generators and other devices operating at 1,000 to 24,000 rpm.

The bearing, called BarTemp, is lubricated by means of a ball retainer of reinforced Teflon compounded with a solid lubricant. As the bearing rotates, microscopic quantities of the lubricant are deposited on the raceway. Prototype quantities are available in .3125 in. to .7480 in. outer diameter. Initial price of prototype angular contact types is $15 per bearing.

Barden Corp., Danbury, Conn.

Jet Oil Test Stand

Test stand checks oil coolers, bypass valves, filter assemblies and bearing housings on Pratt & Whitney JT3 and JT4 turbojet engines.

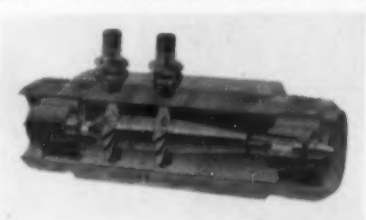
The test unit circulates heated MIL 7808 oil at flow pressures to 100 psi. and static pressures to 600 psi. Temperature is maintained at any level from 80 to 300F, and pressure is constant regardless of flow, which varies from .74 to 125 ppm. Safety features on the test stand include an emergency shutdown button, low level warning light, pressure relief valve and a pump-heater interlock to prevent coking the oil when it is not circulating. Pan American World Airways is operating the maintenance unit at Idlewild Airport.

General Electric's New York Aircraft Service Shop, Linden, N. J.

Mass Flowmeter

Flowmeter for aircraft and missile applications measures liquids or gases in absolute mass units and provides accuracies to ± ¼% of reading with linear response over 10 to 1 range.

The Series 3000 Mass Pottermeter, which requires no external power source or immediate specific gravity correction, handles corrosive and non-lubricating fluids over a temperature range of −430F to 850F. The transducer incorporates two spring coupled rotors of varying pitch. The angular displacement of the rotors is proportional to flow momentum. The entire assembly, however, rotates at a speed proportional to flow velocity. The elapsed time for the phase angle to traverse a reference point provides a direct measurement of mass flow rate.



Potter Aeronautical Corp., Union, N. J.

Prop Feather Warning Light

Propeller feather warning light for twin engine aircraft provides a cockpit warning when an engine develops zero thrust.

The Safeather power failure indicator senses engine torque at the engine mounts and illuminates the feather button when the prop goes into a drag condition. The system is disarmed at low power throttle settings to avoid false alarms.

Aviation Instrument Manufacturing Corp., 9033 Monroe Rd., Houston 17, Tex.

Ballistic Delay Initiator

Ballistic delay initiator, developed for the ejection seat system of the North American T2J trainer, may be modified for various delays and pressure outputs.

The 1.5 oz. initiator, fired by a gas pressure input of 400 to 500 psig., generates a pressure of 2,000 psig. in a closed volume of 0.3 cu. in. after a delay of .5 sec. The special .38 caliber cartridge, modified for delay or instantaneous application, permits the initiator to be used as a booster in long ballistic transmission lines.

Propellex Chemical Division, Chromalloy Corp., P.O. Box 187A, Edwardsville, Ill.

Light Aircraft Fuel Injection

Fuel injection system is designed for supercharged and unsupercharged aircraft engines of 600 hp. or less.

Applicable to either port injection or single point impeller injection, the system incorporates a self-purging servo to eliminate vapor lock yet maintain system within the capabilities of a sim-

From an original painting for CECO by R. T. Handrille

Contributing to the superb performance . . . of North American Aviation's Hound Dog missile is a Pratt & Whitney Aircraft J-52 turbojet equipped with *main fuel pump* engineered and precision-produced by Chandler Evans. The J-57 engines powering Boeing's B-52G "missile platform" bomber are similarly equipped.

Products, too are "known by the company they keep", and CECO is proud to be airborne with an array of important missiles as well as with many of the latest and finest military and commercial aircraft.

CHANDLER EVANS CORPORATION · WEST HARTFORD 1, CONNECTICUT

Interesting, informative literature on many CECO products is yours for the asking. Please address your request to Department 40.

CECO®
SYSTEMS
CONTROLS

KNOW YOUR ALLOY STEELS . . .

This is one of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

Thermal Stress-Relieving of Alloy Steels

In the production of alloy steel bars and parts made of alloy steel, stresses are sometimes set up, and these stresses must be relieved before optimum results can be expected. Two general types of stress-relieving are practiced—thermal and mechanical. In this discussion we shall consider only the former.

There are several important reasons for thermal stress-relieving. Among these are the following:

(1) The first and most fundamental purpose is to reduce residual stresses that might prove harmful in actual service. In the production of quenched and tempered alloy steel bars, machine-straightening is necessary. This induces residual stresses in varying degrees. Bars are usually stress-relieved after the straightening operation. When the bars are subjected to later processing that sets up additional stresses, subsequent stress-relieving may be necessary.

(2) A second major purpose of thermal stress-relieving is to improve the dimensional stability of parts requiring close tolerances. For example, in rough-machining, residual stresses are sometimes introduced, and these should be relieved if dimensional stability is to be assured during the finish-machining.

(3) Thermal stress-relieving is also recommended as a means of restoring mechanical properties (especially ductility) after certain types of cold-working. Moreover, it is required by the "safe-welding" grades of alloy steels after a welding operation has been completed.

Alloy bars are commonly stress-relieved in furnaces. Temperatures under the transformation range are employed, and they are usually in the area from 850 deg to 1200 deg F. The amount of time required in the furnace will vary, being influenced by grade of steel, magnitude of residual stresses caused by prior processing, and mass effect of steel being heated. After the bars have been removed from the furnace, they are allowed to cool in still air to room temperature.

In the case of quenched and tempered alloy bars, the stress-relieving temperature should be about 100 deg F less than the tempering temperature. Should the stress-relieving temperature exceed the tempering temperature, the mechanical properties will be altered.

Items other than bars (parts, for example) can be wholly or selectively stress-relieved. If the furnace method is used, the entire piece is of course subjected to the heat; selective relieving is impossible. However, if a liquid salt bath or induction heating is used, the piece can be given overall relief or selective relief, whichever is desired.

Detailed information about stress-relieving is available through Bethlehem's technical staff. And remember that we can furnish the entire range of AISI standard alloy steels, as well as all carbon grades.

This series of alloy steel advertisements is now available as a compact booklet, "Quick Facts about Alloy Steels." If you would like a free copy, please address your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

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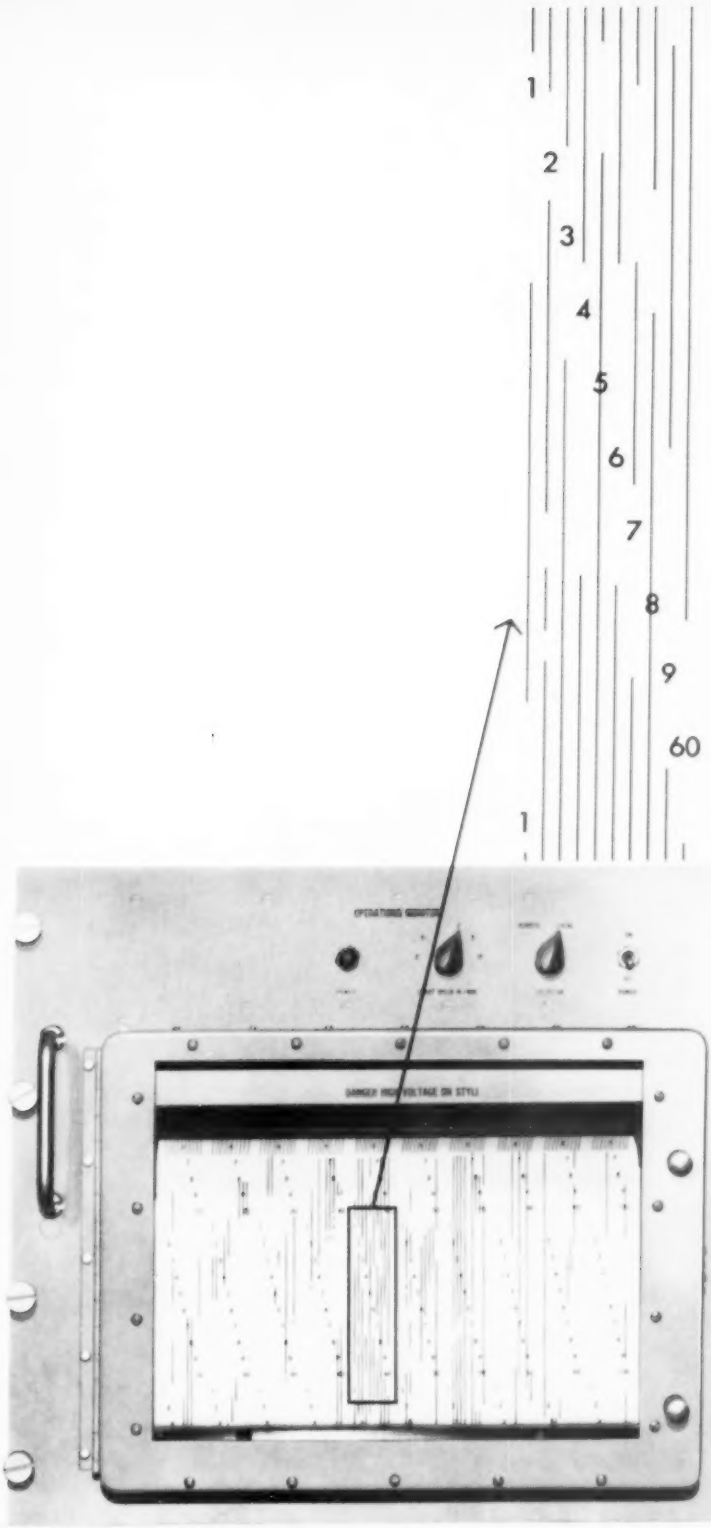
BETHLEHEM STEEL



insight at 4 milliseconds

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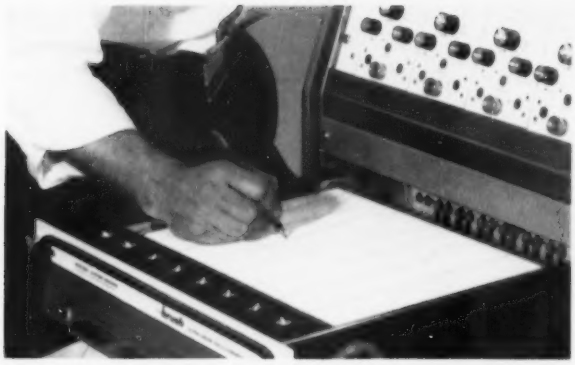

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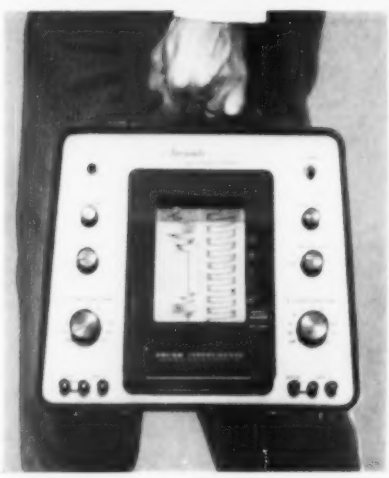

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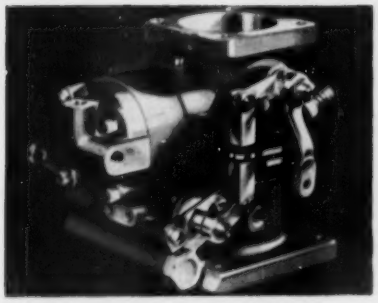
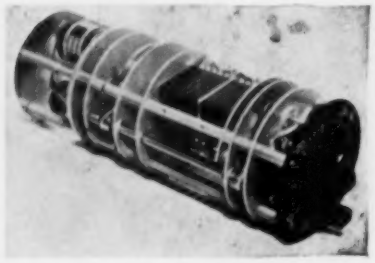


ple diaphragm pump. Fuel flow is proportioned by measuring air flow to the engine.

Engine Equipment Sales, Bendix Products Division, South Bend 20, Ind.

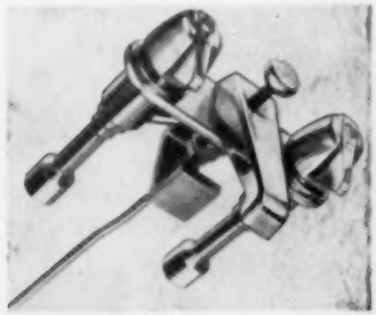


De-Icing Computer

Computer programs the opening and closing of de-icing air ducts which feed 450F air to wing and tail leading edges on jet transports.

Cycling of the timing is controlled by the flight engineer who adjusts the normal cycle from 24 sec. to 480 sec. depending on outside air temperature. The computer, which uses a ball-drive to cycle cam-operated switches, incorporates a 400 cps. a.c. motor 115 v., 30 w. maximum.

A. W. Haydon Co., Waterbury, Conn.



Aircraft Faucet

Hot and cold water faucet is designed for use on commercial transport and executive aircraft.

The self-closing faucet is installed with one lock nut and weighs 2.5 lb. The unit is compatible with gravity or pressure systems to 60 psi. Available in chrome or gold plate.

Bobrick Dispensers, Inc., 1839 Blake Ave., Los Angeles 39, Calif.

TRAFFIC-COP FOR "GO" FUELS
Since they fed the first bird 22 years ago, Grove pressure regulators have set the pace. It is fact that original Grove designs are still the basis for every pressure regulator used in ground support systems today. Specify Grove regulators for dependable pressure control.
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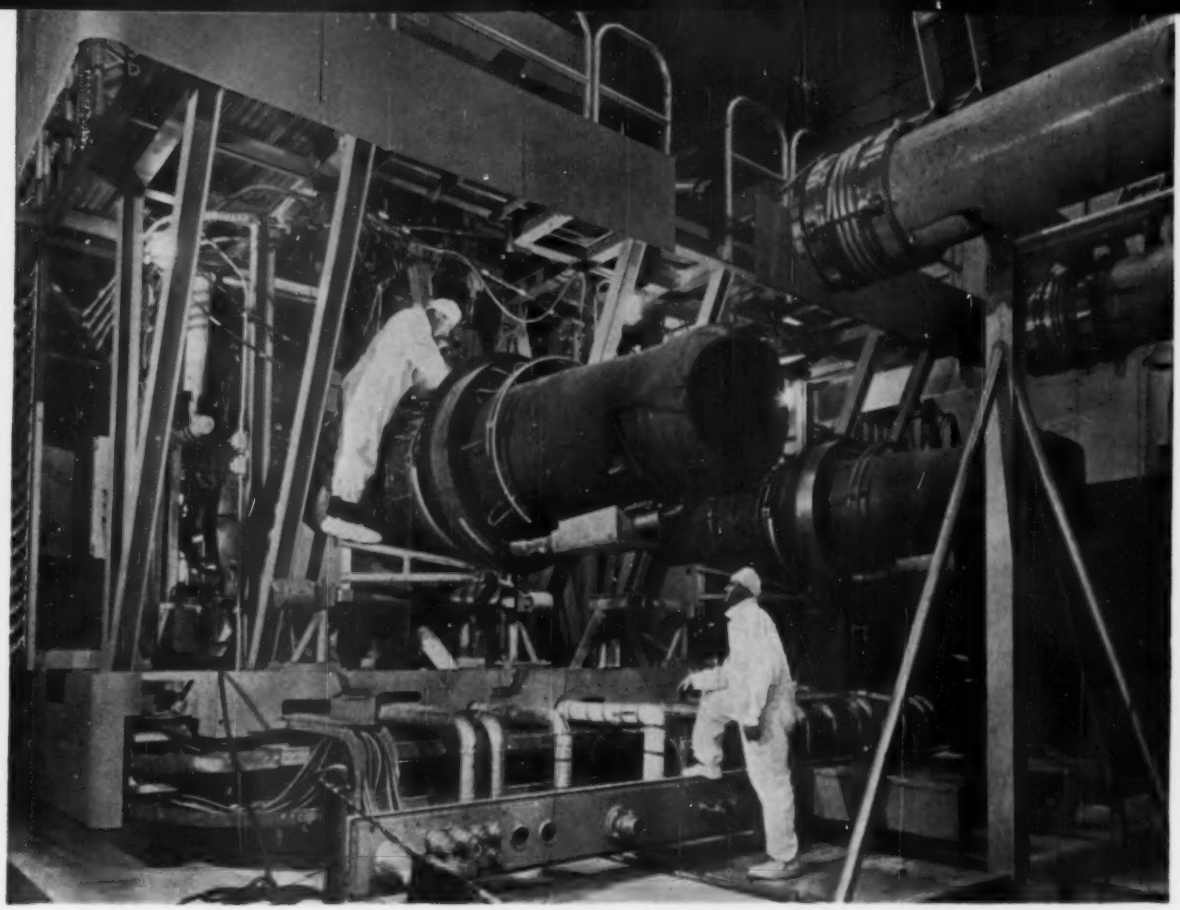
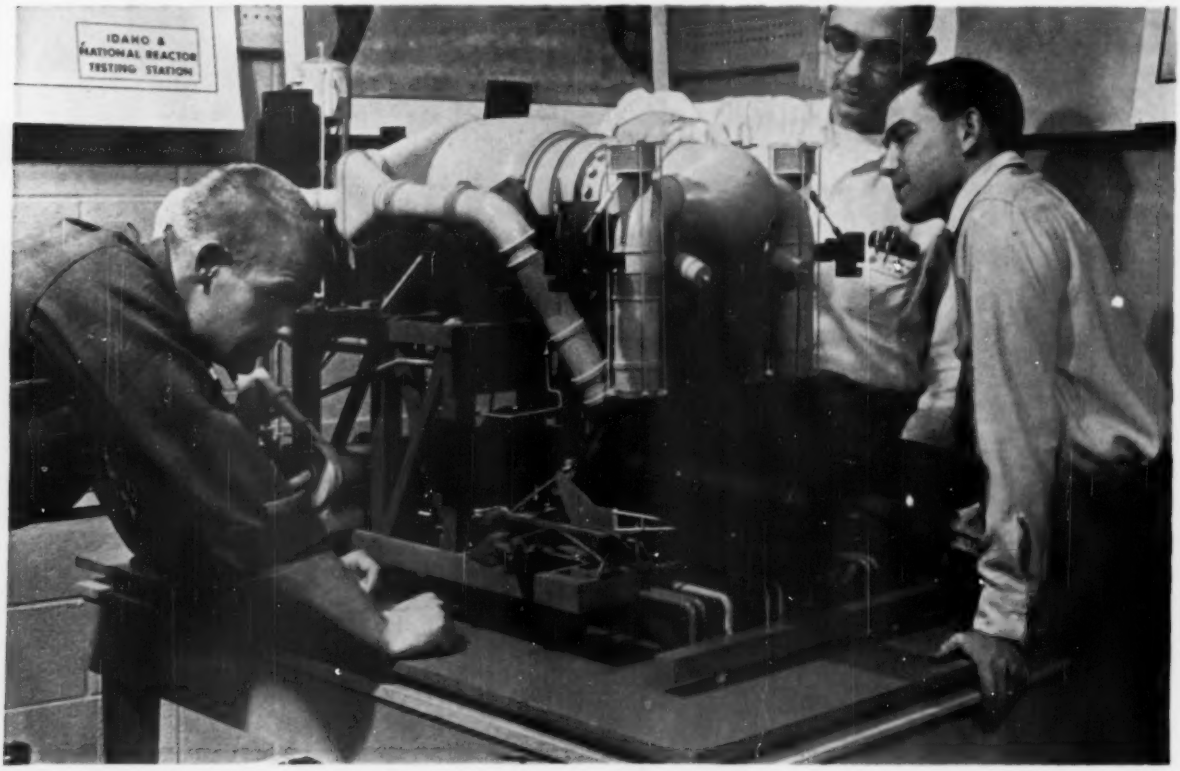


Aircraft Nuclear Propulsion System built by General Electric for USAF and AEC is called Heat Transfer Reactor Experiment No. 3 (AW Sept. 22, 1958, p. 55). Unit recently operated two modified General Electric J47 turbojets for more than 120 hr.



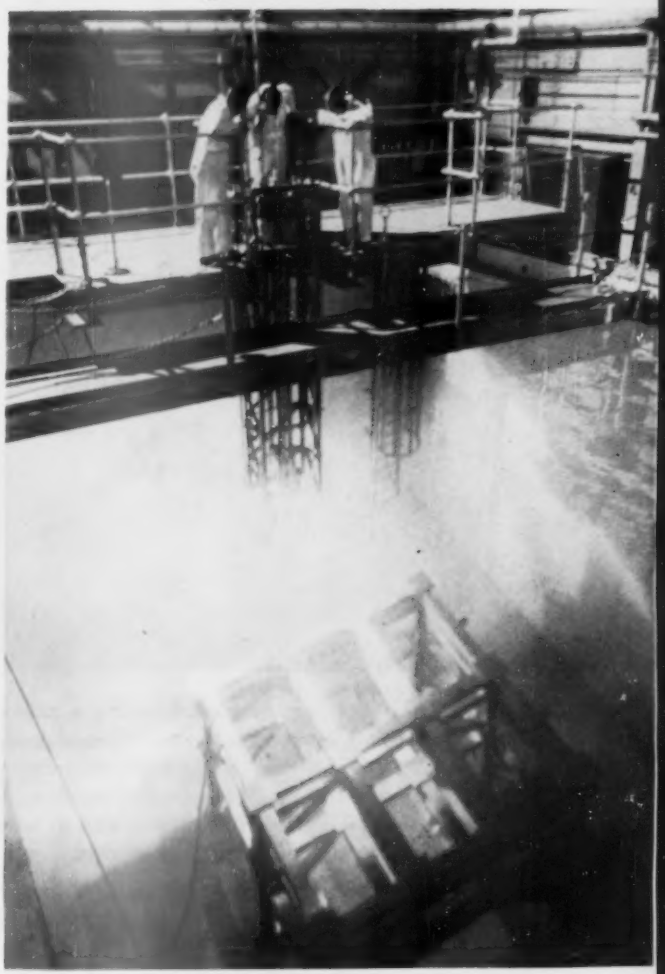
Model shows over-all configuration of GE-built Heat Transfer Reactor Experiment No. 3 (HTRE 3). This test system was the first of its type developed with a reactor positioned horizontally. Goal is a propulsion system with virtually unlimited range for airborne vehicles.

Nuclear flight propulsion system will be ground-tested by GE in this Flight Engine Test Facility at Idaho Falls, Idaho.

Facility Built for Aircraft Nuclear Engine Tests

Flight Engine Test Facility at Atomic Energy Commission's National Reactor Testing Station is operated by General Electric's Aircraft Nuclear Propulsion Department for USAF and AEC. Objective is to develop an aircraft nuclear propulsion system which will give military aircraft almost limitless range. Facility's hangar (above) is 320 ft. long x 234 ft. wide and 99 ft. high. Automobile is emerging from a 1,000-ft. tunnel which leads to a control and data center, covered by the mound of earth in front of the hangar. Cooling tower is in front of control center.

Heat Transfer Reactor Experiment No. 3 (HTRE 3) (opposite page) was built by General Electric to test feasibility of concept and powered two J47s for more than 120 hr. The airborne propulsion system will be a direct air cycle type. HTRE 3 is mounted on a railroad flat car (AW Feb. 22, cover) to facilitate movement between the test facility and maintenance area.



Operating console for critical experiment test reactor at the aircraft nuclear propulsion test site is at left. Pool test reactor (right) is used to measure effectiveness of radiation shielding materials. One-megawatt reactor is 11.5 ft. off floor of 30-ft.-deep pool. Framework in pool is used for positioning test material. Positioning of control rods is checked from bridge which provides access to core.

HEDGEHOPPING AT MACH 1
Lockheed radar shows pilot how to miss what he can't see

When a pilot hugs the deck traveling a mile *every four seconds,* his route is the world's most dangerous obstacle course. Hills, bridges and other hazards can be in his lap before he has time to maneuver safely over them. He needs information well in advance, particularly in poor visibility or at night.

And now he gets it—from Lockheed Electronics terrain avoidance radar. A compact display shows him obstacles, his position in relation to them, and the maneuvers necessary to avoid them—in time.

Lockheed Electronics systems engineers have created in one group of modules the most versatile airborne radar in flight test today. Equally effective as a mapping, bombing or navigational radar, this lightweight, transistorized unit is typical of the sophisticated equipments developed by Lockheed Electronics to help strengthen the nation's defense.

CAPABILITIES—MILITARY SYSTEMS/STAVID DIVISION

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SIMULATION AND TRAINING DEVICES

OPERATIONS ANALYSIS—offensive and defensive systems, war operations, undersea warfare, electronics in space

MINDING THE FUTURE

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HEADS MEAN **IDEAS** AT CHANCE VOUGHT

MISSILES . . . AND PIPELINES? Controls similar to those developed for missile flight test have interesting applications in the petroleum industry. Vought Range Systems Division is demonstrating how these systems can provide automatic control of pipelines, off-shore installations and gathering systems. At Vought, the same men who measured and telemetered 138 variables from a single missile in flight now are actively interested in reducing the petroleum industry's maintenance and operating costs through automatic controls.

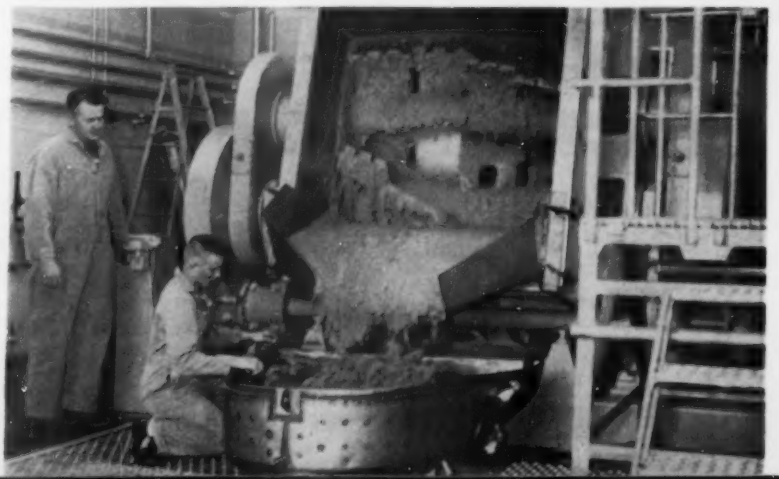
A TEMPERATURE DIFFERENTIAL of at least 3,000 degrees may be expected between the nose cap and cockpit of a manned, maneuverable spacecraft. Choosing materials that will withstand this temperature spread . . . and using them to design *livable* vehicles . . . these are assignments Chance Vought's Astronautics Division is undertaking under contract and at its own expense. In developmental studies of glide re-entry craft and manned lunar vehicles, the Division has successfully balanced wide temperature extremes in a single vehicle.

CHANCE VOUGHT

Aft Closure Installed on Minuteman Stage

Aft closure for Minuteman intercontinental ballistic missile is mated to the third stage engine after final machining at Thiokol Chemical Corp.'s Brigham City, Utah, production facility. Stage is shown above being readied for propellant curing in one of five casting and curing houses (AW Apr. 25, p. 58).

Closure nozzle ports are unfinished (above). Below is Thiokol propellant mixer.



FINANCIAL

Competition Increases For Missile Business

Unlimited vistas of growth implied for the missile business by prices of some stocks in that area may be due for some sobering as harder competition for business by more companies continues.

W. E. Zisch, vice president and general manager of Aerojet-General Corp., told the Los Angeles Society of Security Analysts that the missile industry is shaking down from glamorous growth to stable progress.

Aerojet reported sales of $200,511,325 for the first half of 1960, a 29% increase over the same period in 1959. But sales for the full year of 1959 of $364 million were a 67% increase over the previous year. First half 1960 earnings rose 16% to $4,456,556; for all of 1959 the percentage increase was 36% for a total of $8.2 million.

This "profit deficiency," Zisch said, reflects the closer competitive position into which all aerospace companies are moving. Cost sharing with the government on research and development contracts, required by any company that hopes to retain leadership in the field, is one major factor, Zisch said, and the entry of many new companies into the field is another.

Aerojet's 1960 sales will be on the order of $425 million, Zisch said, and earnings near $10 million. This would indicate an earnings increase of about 20%.

• **Axe Investment Funds** of New York purchased 12,000 shares of Atlantic Research Corp. at a cost of $600,000. The Axe funds had previously purchased 25,000 shares of Atlantic's stock for $1 million in January.

• **Gyrodyne Co. of America** declared dividends on its 5% and 6% preferred stocks and in addition authorized payment of half the dividend arrearage—$1.05 or $1.20 a share depending on when issued—of the 6% preferred. The remaining arrearage payment is expected to be authorized next January. Dividends on the 5% stock are current. Gyrodyne backlog—primarily for the Navy DASH drone helicopter program—now totals $11,300,000.

• **Alitalia** will issue $16 million of 5½% convertible debentures in a move described by the carrier as the first major step in plans to place Alitalia ownership primarily in public hands. About 70% of the stock is now held by the Instituto per la Ricostruzione Industriale (IRI), an Italian government holding company similar to the U. S. Reconstruction Finance Corp. Fiat is

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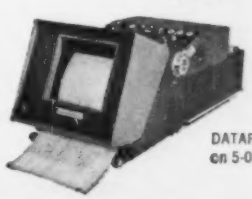
DATAFLASH cover
on 5-036 Magazine

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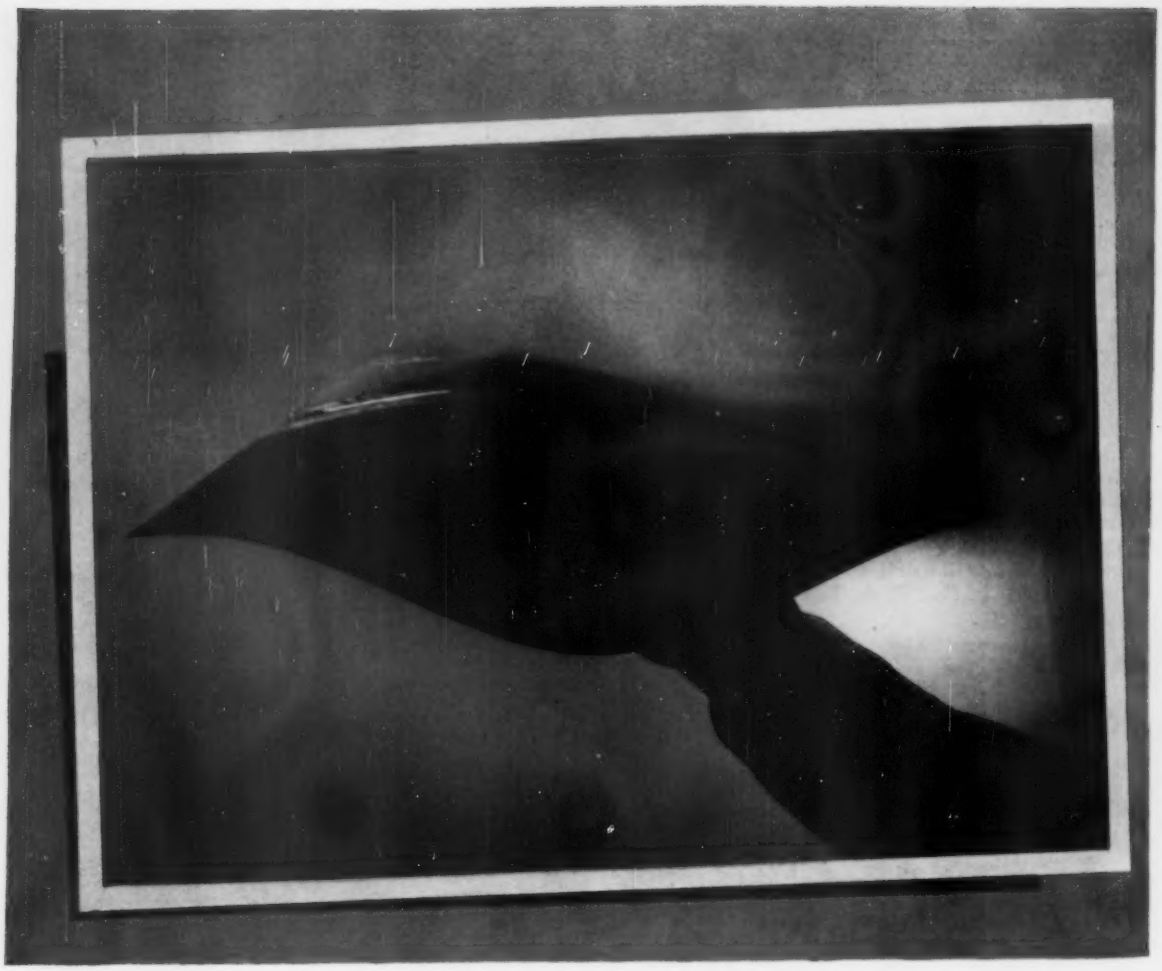

This photo of Grumman was taken at a speed of Mach 8

This is a vapor screen photo of hypersonic flow (Mach 8) about a Grumman research model, at Arnold Engineering Development Center. Expansion region above the body is discernible along with the separated region adjacent to the surface and the reflection of the light screen on the surface.

The photo shows something else, too: Grumman is on the move in the field of hypersonic aerodynamics. Add to that—continuing design and development work on orbiting observatories, unmanned scientific satellites, manned space craft, and re-entry vehicles, to name a few.

Advanced Ideas Grow Into Reality at...

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the largest holder of the other 30%. The carrier reported a $245,803 net profit for 1959, operating at a 55% load factor.

• **First-half sales of** Thompson Ramo Wooldridge, Inc., reached $219.1 million, a gain of $19.6 million over a similar period a year ago. Officials said the increase came mostly through a gain of about 35% in the company's electronics, missile and space business, compensating for a decline in components for manned jet aircraft. Net income after taxes was $5,033,861, compared with $4,926,209 for the first half of 1959.

• **Aeroquip Corp.** reported a sales gain of 17% for the nine months period ending June 30, for a total of $41,185,025 as against $35,186,686 for that period a year ago. Net earnings of $2,169,842 were equal to $1.82 a share.

• **Lear, Inc.,** earnings for 1960 are predicted to average between $1.20 and $1.40 per share of common stock. Included in the 1960 estimate is 29 cents of non-recurring profit from the sale in January of the company's private and business aircraft product line to Motorola, Inc. Sales for 1960 are predicted at $91 million, about 5% higher than the $87 million achieved in 1959, or about 11% higher if the $5 million in 1959 sales of the products sold to Motorola are eliminated from the comparison.

• **ACF Industries, Inc.,** and its wholly-owned SHPX group of companies announced a combined net earning of $5,166,000, equivalent to $3.63 per share of common stock, for the year ended Apr. 30. ACF accounted for $3,933,000 or $2.77 per share, and SHPX $1,233,000 or 87 cents per share. Combined sales, rentals and services were $273,046,000,—ACF $263,611,000 and SHPX $9,435,000.

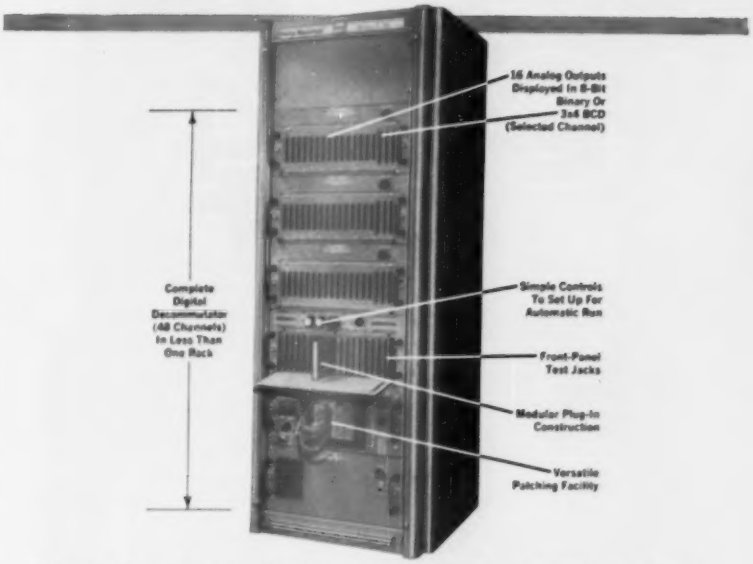
• **Loral Electronics Corp.** Fiscal 1960 sales of $17,439,871 showed a sharp increase over 1959 sales of $7,996,657. The sales produced a net income after taxes of $579,216, against $134,348 for that period last year. Company had a $31 million backlog as of last Mar. 31.

Financial Briefs

• **Model Engineering & Manufacturing Corp.** (MEMCOR) of Huntington, Indiana has acquired controlling interest in Montek, Inc., Salt Lake City, Utah. The acquisition incorporates Montek's electronic and acoustic development work, particularly in the field of electronic controls for atomic reactors, into the MEMCOR organization. MEMCOR facilities already include the "space age" research and development facility at Salt Lake City and Courter Products Division, an airborne instrumentation plant at Boyne City, Mich.

NEW DIGITAL DECOMMUTATOR

Handles PAM with 100% Duty Cycle


16 Analog Outputs Displayed In 8-Bit Binary Or 3x4 BCD (Selected Channel)
Complete Digital Decommutator (48 Channels) In Less Than One Rack
Simple Controls To Set Up For Automatic Run
Front-Panel Test Jacks
Modular Plug-In Construction
Versatile Patching Facility

Only one of many outstanding features of the EMR Model 185 Digital Decommutator is its ability to handle PAM with 100% duty cycle*. Synchronization ability afforded by the all-digital circuitry is such that channel sync is maintained even when up to 20 PAM channels are at the same level with no detectable change.

No other telemetry decommuntation equipment offers the versatility or accuracy of the Model 185. It accepts all standard analog or digital telemetry inputs and provides both analog and digital outputs. From 10 to 128 channels are accepted at any sampling rate from 10 to 4600 pps. For digital outputs, accuracy is 10 bits (0.1%) at sampling rates to 1150 pps; 8 bits (0.4%) at higher rates.

Complete transistorization is responsible for ruggedness and for unusually low power consumption averaging 250 watts. Warmup for fully stabilized operation is virtually instantaneous. Reliability is outstanding, as proved by thousands of hours of trouble-free field operation.

Controls are easy to set up for any combination of operating conditions. Once set, operation is fully automatic.

Condensed Specifications

INPUTS: PAM, PDM, PCM; 10 to 128 channels; level 2 to 100V (PAM) or 0.5 to 100V (PDM, PCM); single or double ended, either polarity.

SYNCHRONIZATION: Pulse rate continuously variable between 10 and 4600 pps; no loss of sync with 12 cps pulse rate variation of ± 20% amplitude, channel pulse jitter of over 500 cps at ± 12%, or 20 consecutive missing pulses.

PATCHING: Plug-in patch panel allows connection of any output to any input, cross-strapping of any channels, reference channels anywhere in frame, any number of channels per frame.

LINEARITY: ± 0.04% of best straight line.

REFERENCE CORRECTION: Manual or automatic operation standard.

STORAGE DECAY: None.

DIGITAL OUTPUTS: Parallel binary, 10 bits; BCD 3 × 4 bits; 10V p-p; rise time 2 μs; impedance 2K single ended.

ANALOG OUTPUTS: Std., ± 2.5V into 4.7K; pen or film recorder drive available; instantaneous response to f. s. step change.

SIZE: 26¾" × 19" w. plus 8¾" h. each for 16-output analog drawer, 16-output 8-bit binary drawer, PCM input drawer, or printer drive drawer.

See the Model 185 at the Symposium on Space Electronics and Telemetry, Washington, D. C.

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The Copyflo 1824 printer makes 18" x 24" prints, or smaller, *on ordinary paper* at an extremely low cost. Also reproduces on vellum and offset paper masters.

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Write today for 1824 booklet giving the full benefits you can expect from a Copyflo 1824 printer. HALOID XEROX INC., 60-102X Haloid St., Rochester 3, N. Y. Branch offices in principal U. S. and Canadian cities. Overseas: Rank-Xerox Ltd., London.

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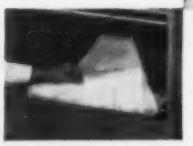
A. Operator inserts microfilm aperture card.

B. Next, inserts sheet of ordinary paper, vellum or offset master material.



C. The first print is automatically delivered in 30 seconds, subsequent prints (of the same or different drawings) every 15 seconds.

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WHAT'S NEW

Reports Available:

Pilot's Handbook on Airplane Performance—Aeronautical Consultants & Associates, Inc., 1695 Merrick Avenue, Merrick, N. Y. $5.00; 52 pp. 8½x11 paper.

Tungsten Chemicals Specification Catalog—Sylvania Electric Products, Inc., Chemical and Metallurgical Division, Towanda, Pa. No charge.

Properties of Beta Titanium Ti-13V-11Cr-3Al—Titanium Metals Corp. of America, 233 Broadway, New York 7, N. Y.

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.

Physical and Mechanical Properties of Columbium and Columbium Base Alloys—E. S. Bartlett and J. A. Houck, Defense Metals Information Center. February, 1960. $1.75; 66 pp. (PB 151082)

Ultra High Temperature Study—A. V. Grosse and C. S. Stokes, Research Institute of Temple University for Wright Air Development Center, U. S. Air Force. $1.00; 26 pp. April, 1959. (PB 161460)

Solar Energy Report—R. J. Marcus, Stanford Research Institute for Air Force Office of Scientific Research. December, 1959. $.50; 6 pp. (PB 161462)

Aerodynamics Literature Surveys Cover Forces Affecting Aircraft—Part XV—M. Z. Krzywoblocki, University of Chicago. January, 1959. $1.75; 67 pp. (PB 161548)
Part XXIV—M. Z. Krzywoblocki, University of Chicago. January, 1960. $3.50; 241 pp. (PB 161549)

A Survey of Solid-State Light Amplifiers and Allied Devices—J. Ruhge, Ordnance Test Station, U. S. Navy. November, 1959. $1.75; 66 pp. (PB 161465)

Organic Semiconductors—D. E. Laskowski and others, Illinois Institute of Technology for ARDC. December, 1959. $1.25; 41 pp. (PB 161459)

Solutions for Complex Systems of Chemical Reaction Kinetics—D. D. Konowalow and others, University of Wisconsin for Wright Air Development Center. August, 1959. Part I. $1.25; 44 pp. (PB 161408)

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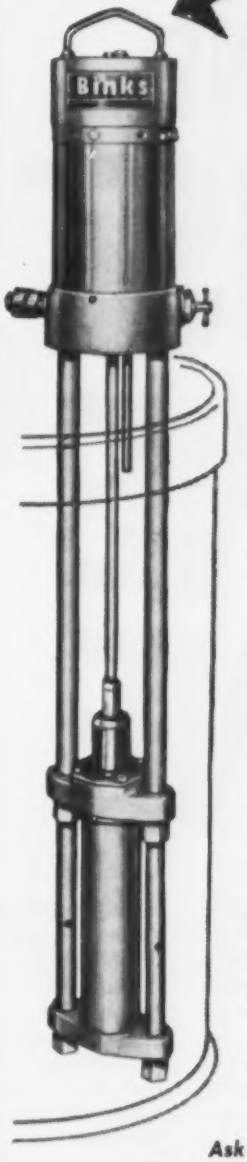

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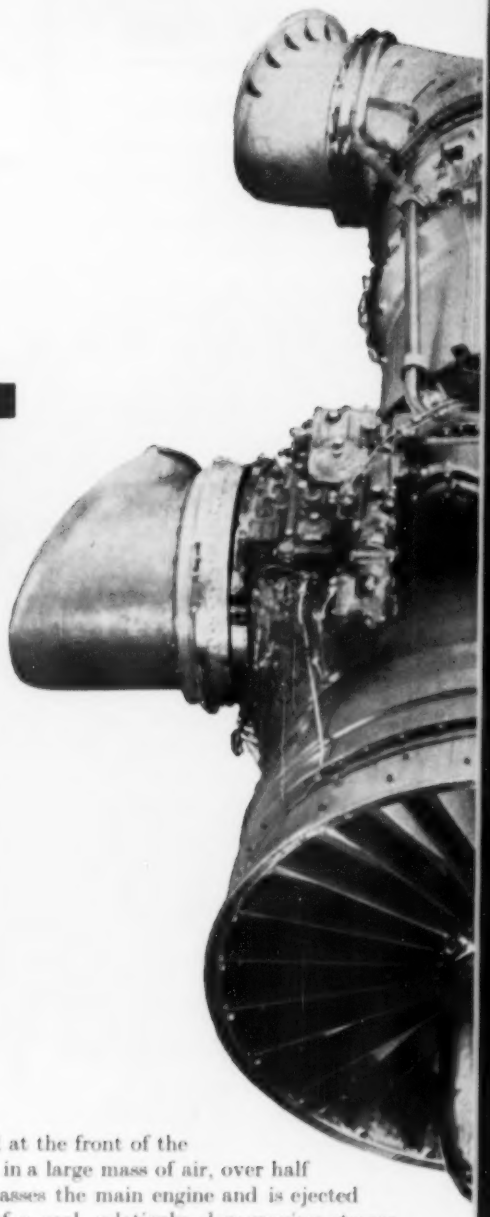

A single power source for VTOL and STOL aircraft. The new Bristol Siddeley BS 53 high-ratio turbofan represents a major engineering breakthrough in the field of VTOL and STOL aircraft propulsion because it provides the airframe designer with a single power source *for all conditions of flight*.

VTOL, STOL and normal take-off capability. The most revolutionary feature of this unique engine is that the thrust can be evenly applied around the centre of gravity through four movable nozzles which are directed downwards for lift, backwards for thrust, forwards for braking in flight, or in any intermediate direction. This makes possible, for the first time, the design of single or multi-engined aircraft in which the total installed thrust is available for vertical or short take-off with a normal payload or for conventional take-off with a large overload.

High cold-flow ratio, high thrust, low fuel consumption. The BS 53 is a high-thrust engine and the basic design concept which makes its versatile performance possible is a high cold-flow ratio.

A fan, located at the front of the engine, draws in a large mass of air, over half of which by-passes the main engine and is ejected in the form of a cool, relatively slow-moving stream through the two forward nozzles. The remainder passes through the gas generator and supplies thrust to the two rear nozzles. This arrangement greatly improves the Froude efficiency and gives the BS 53 a higher thrust/weight ratio, a lower specific fuel consumption and a lower noise level than any turbojet of comparable power in existence today.

Conventional installation, operational simplicity. The BS 53 is installed normally, with forward-facing intakes and the majority of its components are based on well-known principles already proved in service. These factors make for operational simplicity, easier maintenance, greater reliability.

Reduced problems of ground erosion and recirculation. Because the velocity and temperature of its jet effluxes are low, the BS 53 minimises the problems of ground

THE REVOLUTIONARY
BS 53
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erosion, recirculation and ingestion of debris which are a major difficulty with fixed lifting engines. All ground running can be done with the exhaust discharging backwards like a conventional turbojet. Taxying also is perfectly normal, and at take-off a short forward roll before the nozzles are deflected downwards ensures that all debris is left behind. As a result, the BS 53 does not require prepared sites and is *independent of all fixed ground installations.*

Selected for the world's first VTOL fighter. The Bristol Siddeley BS 53 has received the support of the Mutual Weapons Development Programme for NATO, and has already been selected for the world's first fixed-wing, aircraft designed for operational service with V/STOL capability—the Hawker P 1127. Although this remarkable engine was primarily designed for this type of aircraft, it is equally suitable for any single or multi-engined, subsonic or supersonic aircraft which requires VTOL or STOL capability.

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BELL 204B demonstrator, to be shown for the first time at the NBAA meeting in Los Angeles next week, has civilian paint and interior, including complete communications and navigation system. Price of the turbine-powered Model 204B will be approximately $285,000.

Bell Modifies HU-1B for Civil Market

By Erwin J. Bulban

Ft. Worth, Tex.—Campaign to get a first-hand market reaction to a civilian version of the HU-1B turbine-powered helicopter will get its start in Los Angeles, Calif., next week when Bell Helicopter Corp. introduces a commercial 10-place Iroquois at the National Business Aircraft Assn.'s annual meeting for the first time.

Following demonstrations in Los Angeles, the Bell 204B will go on an extensive tour of the United States and Canada to show the new craft to corporate and charter operators.

The helicopter manufacturer will be quoting a price of about $285,000 for the 204B, including powerplant and a standard interior.

Availability of the 204B to corporate and charter operators, however, will be dependent upon certification by the Federal Aviation Agency, and this in turn will hinge upon when sufficient civilian response is obtained to justify the cost of this procedure, which could run well over $500,000.

Bell officials are prepared for a long-term campaign to "sell" the helicopter concept to the civilian market, noting that there are only 125-150 commercial helicopters operating domestically and there is a long road ahead for the rotary wing industry in expanding this field. A major selling job has yet to be done in convincing many users of fixed wing corporate aircraft that the new generation of large turbine-powered helicopters, capable of carrying good-size payloads and extensive communications and navigation equipment necessary for cross-country flying without penalty, could be more efficient than conventional air transport over distances of approximately 150 mi.

Bell hopes that some of the helicopter's potentialities will be realized by corporate aircraft users attending the NBAA meeting, which is featuring a forum on use of rotary wing craft by industry.

The showing at Los Angeles will also mark the availability of the HU-1B to the world market. Actually this is the area, particularly sales to friendly foreign governments, where Bell expects to make its biggest headway initially, since considerable interest has been expressed by military agencies abroad in the HU-1B, the company says. Since such sales are negotiated by the company directly with the agencies concerned, they are considered commercial business.

Also, granting of production and sales license to Construzioni Aeronautiche Giovanni Agusta, Milan, Italy covering the European market and a similar agreement under negotiation with Mitsui Bussan Kaisha, Ltd., Tokyo, Japan, for Asian markets, is further expected to broaden the 204B's potential sales.

Indications are that Agusta will offer a commercial version of the HU-1B with other than Lycoming turbine engines and will undertake certification of such a version abroad, prior to waiting for Bell to receive FAA certification here.

Bell estimates that it could make deliveries of the 204B to friendly foreign governments in late 1961, fitting these orders into the line that will by then be well into production of the equivalent HU-1B for the U. S. Army.

Specifications available on the Model 204B show that it can carry nine passengers and a pilot or up to 4,000 lb. of cargo. It will have the Lycoming T53-L-9 turbine, delivering 1,100 shp. at takeoff or 960 shp. at maximum continuous power. With this engine the

Model 204B has a 2,660-fpm. rate of climb and a top speed of 147 mph. Hovering ceiling in ground effect on a standard day is stated to be 17,600 ft. Range is 260 stat. mi.

The 204B to be demonstrated at the NBAA meeting in Los Angeles will actually be a hybrid HU-1A and HU-1B, equipped with the HU-1B's wider chord (21 in.) main rotor blades of honeycomb construction and the Lycoming T53-L-1 engine, delivering 770 shp. Its cabin, designed and installed by Horton & Horton, Ft. Worth, will have a rear row of five seats, ahead of it a row of three seats, and one seat on the left side next to the pilot for the ninth passenger.

Communications Package

Equipment includes a complete communications package, loaned by Aircraft Radio Corp., including Type 210 primary and Type T-25 secondary communications gear; two Type 15F VHF navigation sets, one with R-13A glide slope receiver; two Type 21A ADFs; Type R-33 three-light marker beacon receiver, Type CD-3 course director; a Sperry C-4 navigation compass, Lear VGI primary attitude system and J-8 alternate attitude indicator.

Bell points out that the 204B will feature a 1,000 flight hour major overhaul period. Also noted are these component replacement times, as experienced by U. S. Army in the field: complete engine change, 20 min.; main rotor and hub change, 20 min.; main generator change, 10 min.; removal and replacement of battery, 5 min.; transmission change, 40 min. The Lycoming T53 free turbine engine already has accumulated some 50,000 flight hours.

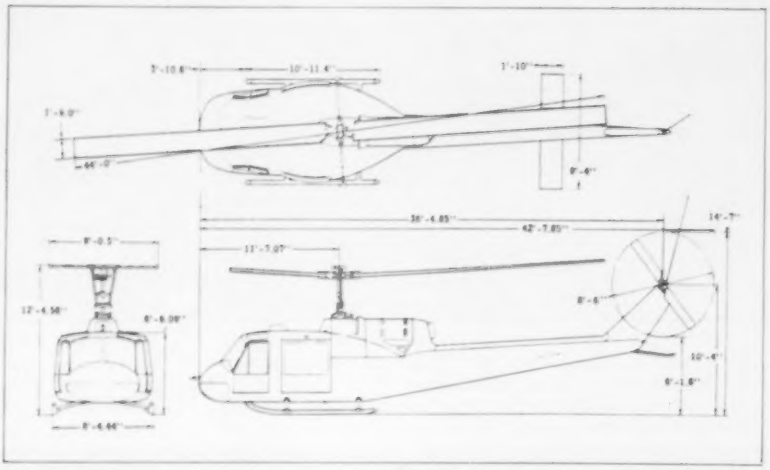
Bell Model 204B

One Lycoming T53-L-9 at 1,100 shp. takeoff*

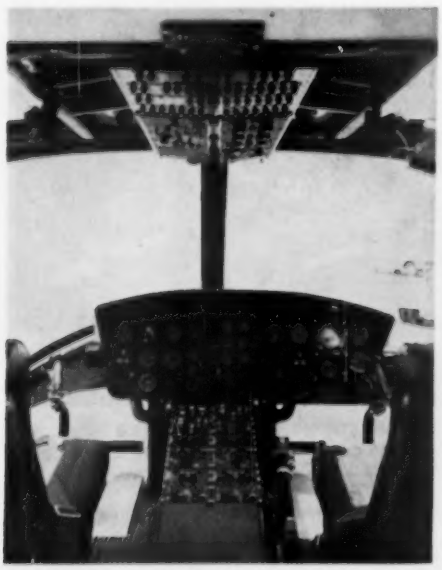
	Passenger Version	Cargo Version
Gross weight	6,500 lb.	8,500 lb.
Useful load	2,182 lb.	4,182 lb.
Empty weight	4,318 lb.	4,318 lb.

Top speed (sea level)	147 mph.
Most economical cruise speed (6,000 ft.)	216 mph.
Maximum rate of climb	2,660 fpm.
Hovering ceiling (in ground effect)	17,600 ft.
Hovering ceiling (out of ground effect)	13,000 ft.
Fuel consumption (cruise speed)	73 gph.
Standard range (10% fuel reserve)	260 stat. mi.
Endurance (10% reserve)	2.8 hr.

*Performance is based on passenger configuration.



MODEL 204B will carry nine passengers and pilot or a maximum cargo load of 4,000 lb. The helicopter will have a 1,000 flight hour major overhaul period, Bell says.



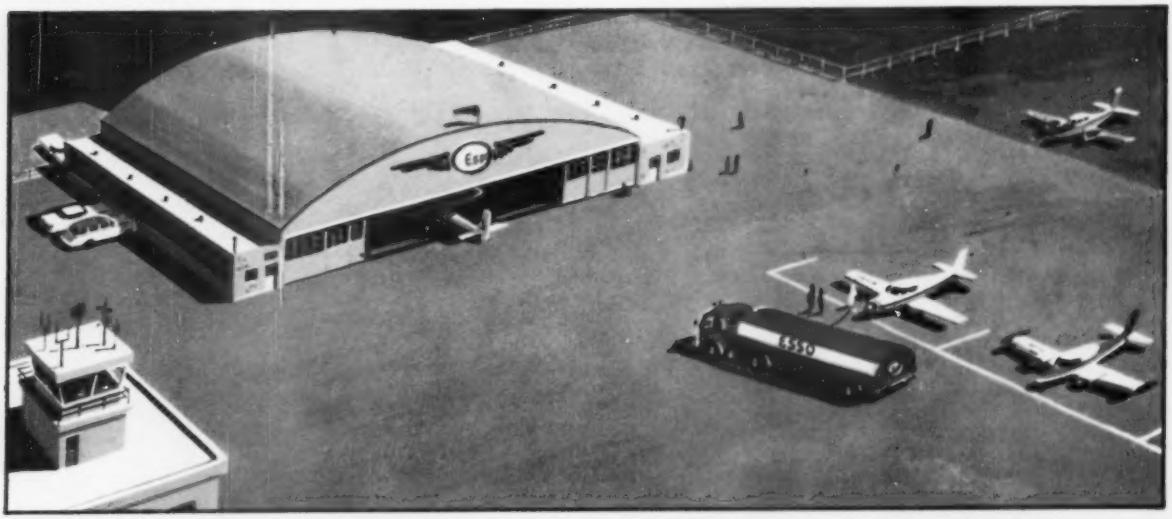
INSTRUMENT WEATHER capability of the Model 204B is indicated (left) by extensive installation of Aircraft Radio Corp. equipment. Pilot sits on the right side. Photo at left shows seating: five passengers are accommodated in rear, three in center and one next to the pilot. The seats can be quickly removed for conversion to cargo configuration. Helicopter may be produced in Italy and Japan.

ESSO

WING TIPS

WATCH THE BIRDIE. Whenever your plane is "staked out," even for a day or two, check your engine before take-off. Birds have a tendency to build nests in sheltered spots. An unnoticed nest near an engine in flight can lead to overheating or a mighty serious fire hazard.

DON'T BE AN EAGER AVIATOR. Don't rush to get "upstairs" with the sudden clearing of bad weather. Avoid taking foolish chances. Too many pilots have found themselves in an IFR situation with little or no instrument experience.



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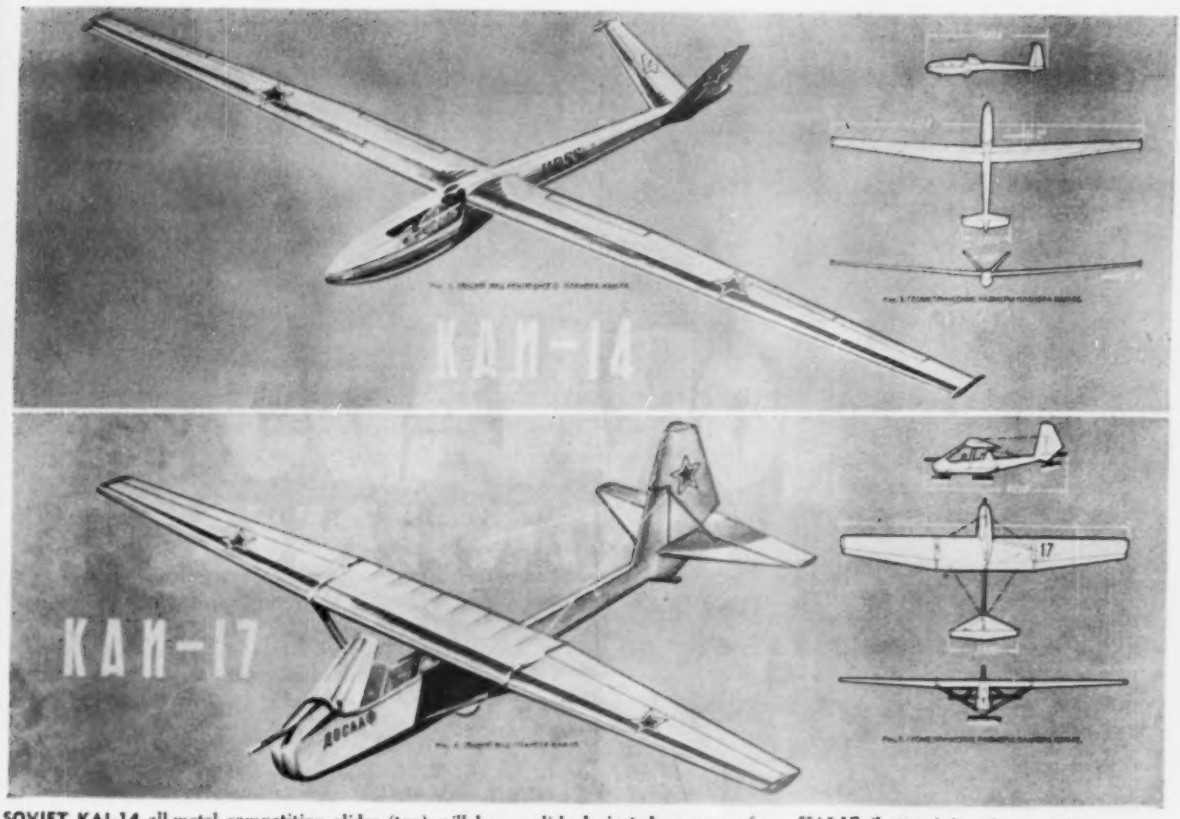

SOVIET KAI-14 all-metal competition glider (top) will have polished riveted seams, surface. KAI-17 (bottom) is primary trainer.

Soviets to Produce Competition Glider, All-Metal Club Trainer

Russia's drive to capture the lion's share of world gliding records has sparked increased glider design and construction activity in the USSR.

Two new, all-metal Soviet gliders are being readied for production by a design team headed by M. P. Simonov. The craft are the single-place, high-performance KAI-14 and the two-place KAI-17, which is intended as a primary trainer for gliding clubs.

V-Tail KAI-14

The V-tailed KAI-14 sailplane—said to incorporate the latest advances in both the USSR and abroad—will be built in "record-setting" and "serial" versions. The former will feature polished riveted seams and polished surface. Pilot will be in a reclining position in the narrowed, bullet-shaped cockpit.

In the "serial" version, the pilot will be seated. The craft will have conventional riveted seams and unpolished surface.

The KAI-14's high aerodynamic efficiency stems primarily from the elongation of its cantilever wing, the midship narrowness of the semi-monocoque fuselage, the smaller wetted surface of the air brakes at the trailing edge of the wing, and the completely-streamlined landing gear.

Pneumatic Gear

Pneumatic landing gear wheel is located forward of the center of gravity. The wheel, which is not equipped with shock absorption, has an exterior braking device working off the air brake stick to simplify the pilot's work in landing.

The Russian magazine Krylya Rodiny (Wings of the Fatherland) has published estimated performance data for the KAI-14 showing it to be more efficient than any foreign standard-class glider taking part in the 1958 world championships. These include such craft as the Breguet-905, the Mukha (Fly)-Standard and the K-6.

The KAI-14 has a wing span of 15 meters (49.2 ft.), length of 5.82 meters (19.1 ft.) and a flying weight of 260 kilograms (573 lb.).

Other data include: permissible towing speed 140 kph. behind an airplane and 100 kph. with an automobile winch, maximum safe flying speed 250 kph., safety factor 9, best speed without air brakes 84 kph. and with air brakes 69.3 kph., minimum speed 65.2 kph., and landing speed 61.5 kph.

The KAI-17 has a wing span of 13 meters (42.7 ft.) and length of 6.22 meters (20.4 ft.). Flying weight with one pilot is 233 kilograms (514 lb.) and with two pilots 323 kilograms (712 lb.).

Other KAI-17 data is: permissible towing speed behind aircraft 140 kph. and with a motor winch 90 kph., maximum safe flying speed 250 kph., minimum sinking speed with one pilot 0.9 meters/sec. and with two pilots 1.06 meters/sec., landing speed with one pilot 38 kph. and with two pilots 46 kph., best speed with one pilot 53 kph. and with two pilots 63 kph., and best gliding ratio 14.

Sabena Considering Taxi-Plane Service

Brussels, Belgium—Sabena Belgian World Airlines is conducting a market survey to determine whether interest in private flying warrants the setting up of a new executive plane service in Europe.

The airline says that an increasing number of large firms in Europe want

Photograph Courtesy U. S. Weather Bureau

When this first photograph of a tornado cloud was taken in 1884, there was no way to warn others of the violence and destruction to come.

Since then, weather forecasting has developed into a major science. Weather disturbances are anticipated with remarkable accuracy—warnings issued sometimes days in advance. Yet military and civilian agencies responsible for aviation weather forecasting require even greater accuracy. They are demanding better methods for collection of weather information, faster transmission of this information and better forecasting techniques.

United Aircraft Corporation is assisting the Government in developing an integrated, semi-automatic weather system. The program is jointly supported by the Department of Defense, the Federal Aviation Agency and the Department of Commerce. New operational concepts and techniques are to be explored; new hardware and a high-speed communication system to be developed.

Initially, the system will consist of a multi-station test network on the Atlantic Seaboard. The equipment and techniques evolved in this facility will form the basis for a national and global system.

Nothing like this has ever been attempted before in the weather area. Thus the program offers electronic engineers and others exceptional challenge and opportunity. To the right men, it can mean professional recognition in a new and exciting field.

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UNITED AIRCRAFT CORPORATION/EAST HARTFORD, CONN.

Piasecki PV-18 Undergoes Certification Tests

Federal Aviation Agency flight certificate for a Piasecki PV-18 is being sought by M. P. Aircraft Corp., San Diego, Calif., in cooperation with Navy and the manufacturer. M. P. Aircraft plans to use the helicopter for forestry rescue and supply missions under CAM Part 8 if certificate is granted. The former Navy helicopter has an electrically-actuated floor hatch and hydraulic rescue hoist originally installed for plane guard duty. Powerplant is a supercharged Wright R975-46 engine. Removal of military communications equipment, IFR instrumentation and autopilot systems provides a 2,000-lb. payload capability, the company says. External sling loads to 1,500 lb. can be carried, according to M. P. Aircraft.

to take advantage of such a taxi-plane service enabling businessmen to travel quickly, independent of set timetables and routes of the regular airlines and therefore resulting in saving of much time.

If results of the survey enable Sabena to go ahead with the plan, a certain number of the interested firms will have to be requested to undertake to lease a minimum number of flying hours per year.

Sabena owns seven twin-engine, four-seat Cessna aircraft used up to now for training purposes. These could be switched to the new service and, because the planes are amortized and Sabena has trained pilots available to fly them, would cost per aircraft and flying hour only about $50.

U.S. Business & Utility Aircraft Shipments

June, 1960

Make and Model	Number of Units	Net Billing Price
Aero Design Model 800	11	
Model 560E	2	$1,011,000
Model 680E	2	
Beech Super 18S	6	
Model 65 Queen Air	7	
Model 33 Debonair	17	$3,686,000
Model 35 Bonanza	26	
Model 50 Twin-Bonanza	8	
Model 95 Travel Air	13	
Cessna 150	52	
172	78	
175	29	
180	28	$4,263,000
182	51	
210	32	
310	26	
Champion 7EC Traveler	1	
7FC Tri-Traveler	1	
7GC Sky-Trac	1	$143,000
7GCB Challenger	18	
7JC Tri-Con	0	
DX'er	1	
Mooney Mark 20	12	$233,000
Piper PA-18	20	
PA-18-A Super Cub	1	
PA-22 Tri-Pacer	32	
PA-23 Apache	12	$3,483,000
PA-23 Aztec	40	
PA-24 Comanche 180	24	
PA-24 Comanche 250	32	
PA-25 Pawnee	54	
Totals	637	$12,798,000

Note: Shipments of U. S. business & utility aircraft in the first six months of Calendar 1960 have totaled 4,412 units with a gross net billing at the factory of $86,598,000, an increase of 8.5% in the number of units and 27.5% in dollar volume over the same period last year.

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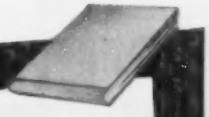

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Just Published—2nd Ed. Gives 600 questions and accepted answers to help engineers pass state license examinations. Covers mechanical, electrical, civil and chemical engineering. **By W. S. LaLonde, Jr., Newark Coll. of Eng. 2nd Ed. 615 pp., 273 illus., $7.50**

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AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command:

The General Tire & Rubber Co., Akron, Ohio, wheel assembly, nose, 12.50-16, type III, magnesium alloy, FSN 1630-516-6765, 737 ea., spares for C-130 series aircraft, Coast Guard spares for SC-130B aircraft, IFB 33-600-60-197(PR's 00-0-1630-5732 and ES-0-1630-6946), $76,095.

Chicago Aerial Industries, Inc., Melrose Park, Ill., cameras, still picture, type KA-30, 71 ea., and data for A3D-2B aircraft (Navy), (MIPR R60-2022-69-NOas), $480,191.

Goodrich Aviation Products Division, B. F. Goodrich Co., Akron, Ohio, wheel assemblies, main, 20x4.4, type VII, FSN 1630-540-9096, Aerno 41-1197 166 ea., brake assemblies for 20x4.4 wheel, main, type VII, FSN 1630-555-7523 for installations on and spares for T-38 aircraft, PR's ES-0-1630-6564, ES-0-1630-6581 and ES-0-1630-6742), $162,855.

North American Aviation, Inc., Los Angeles Calif., supply storage and maintenance and overhaul in support of T-39 flight test program, (PR TR-0-1510-5701), $70,000.

Chicago Aerial Industries, Inc., Melrose Park, Ill., spare parts for A-28 magazine, C-4 control master, B-4 ejector and model VF-21 viewfinder, (PR MO-0-6760-12821), $34,686.

Hughes Aircraft Co., Culver City, Calif., amplifiers, contractor's P/N 464221-150, Aerno 52-9098, 34 ea.; amplifiers, contractor's P/N 464421-150, Aerno 52-9090, 24 ea.; amplifiers, contractor's P/N 464621-150, Aerno 52-9091, 34 ea.; accelerometers, contractor's P/N 464161-150 or 151, Aerno 52-9092, 34 ea., components of automatic flight control system AN/ASQ-25 for F-106 aircraft, (PR DC-0-1270-4088), $204,000.

Federal Systems Division, International Business Machines Corp., Oswego, N. Y., varying quantities of components of the AN/ASB-9 bombing navigation system used in B-52 aircraft, (PR WR-60-1280-4762), $108,079.

Collins Radio Co., Cedar Rapids, Iowa, components of the AN/ASQ-37 subsystem for the F-105D aircraft, (PR RG-0-5895-7303 and amendment No. 1), $289,040.

Hazeltine Electronics Division, Hazeltine Corp., Little Neck, N. Y., power supplies, PP-1852/ASQ-37, contractor's P/N A21415-1, Aerno 81-7464, receiver-transmitter radio, RT-437/APX-37, contractor's P/N A21154, Aerno 81-8217, components of AN/ASQ-37 subsystem for F-105D aircraft, (PR RG-0-5895-7305 and amendment 1), $41,000.

Olympic Radio and Television Division, The Siegler Corp., Long Island City, N. Y., amplifier, synchro signal, compass, type ME-1A, Aerno 60-3861, 1,167 ea., (PR SM-0-05A-1635), $308,274.

Sperry Gyroscope Co., Division, Sperry Rand Corp., Great Neck, N. Y., indicator, type TRU-2A/A, Aerno 60-5602, 107 ea., spare parts, ground support equipment and data for USAF installations and spares for F-105D, T-38A, T-39B and B-52H aircraft, (PR's ES-0-6610-7129, ES-0-6610-7180 and ES-0-6610-7011), $354,551.

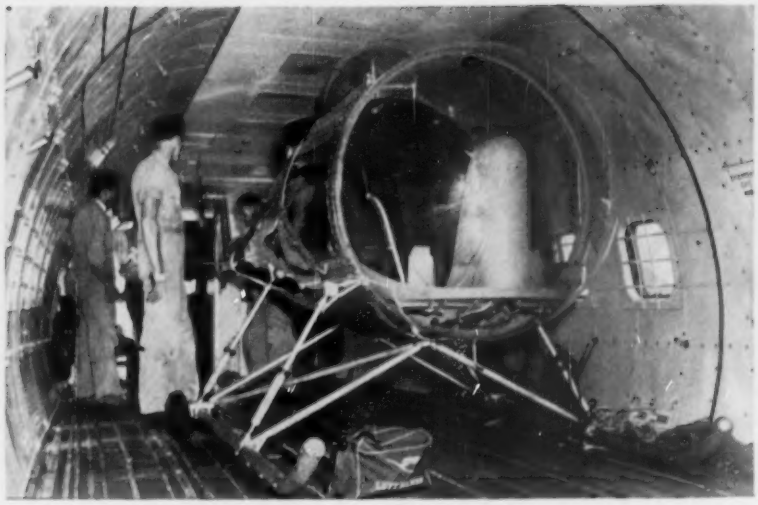
Lockheed Aircraft Corp., Marietta, Ga., JetStar model GL-1329 aircraft, publications, development and testing, PR TK-0-1510-5109), $2 million.

Laboratory for Electronics, Inc., Boston, Mass., engineering technical services, evaluation and flight testing of AN/APN-105 (XY-3)(APN-116) doppler navigator and the AN/APN-105 and AN/APN-131 doppler navigators, (PR EC-0-S-6748), $52,836.

Bell and Howell Co., Chicago, Ill., photographic pods, spare parts and test equipment, MIPR's R60-2021-67-NOas and R60/267/383NSF and amendments 1, 2 and 3, $172,905.

The Goodyear Tire & Rubber Co., Akron, Ohio, wheel assemblies, main, 36x11, type VII, Aerno 41-8564, 454 ea.; brake assemblies, for 36x11 wheel, main, type VII, Aerno 41-8565, 575 ea., spare parts and related data (PR Nos. 00-0-1630-5787, ES-0-1630-7005 and ES-0-1630-7006), $55,961.

Advanced Products Division, ACF Indus-



Brantly Exports B-2 to Germany

Brantly B-2 helicopter is loaded aboard a Lufthansa Lockheed Super Constellation for shipment to Nuremberg, Germany; aircraft was bought by Krautheim Aircraft for use in Austria. The helicopter is the fourth exported to Germany by Brantly Helicopter Corp., Frederick, Okla.

tries, Inc., St. Charles, Mo., removal and preparation for shipment, (PR PR-9-F-9043), $25,000.

Astronics Division, Lear, Inc., Santa Monica, Calif., development and fabrication of airborne flight path computer system, spare parts and data, (PR 65224), $73,014.

Kearfott Division, General Precision, Inc., Little Falls, N. J., components for heading computer systems, AN/AJA-1, (PR MA-0-05A-1248), $109,287.

General Electric Co., Johnson City, N. Y., components of AF/A42G-8 flight control system for F-105D aircraft, (PR's ES-0-66 15-6832), $920,000.

Hazeltine Electronics Division, Hazeltine Corp., Little Neck, N. Y., additional facilities in support of Mark XII IFF system training and maintenance program, (PR 86705), $110,423.

Laboratory for Electronics, Inc., Boston, Mass., radar improvement for certain components of radar sets, AN/APN 131, data and reports, (PR EC-C-8T-6817), $395,825.

Bell Aircraft Corp., Buffalo, N. Y., removal and preparation for shipment of excess facilities, (PR BI-0-S-9010), $42,500.

Mine Safety Appliances Co., Pittsburgh, Pa., explosive vapor detection systems, (PR EM-9-RD-6293 and amendment 1), $125,149.

The Marquardt Corp., Ogden, Utah, RJ43-MA-11 ramjet engines in accordance with Marquardt specification 5602C, dated Sept. 12, 1958, Aerno 35,6239, 377 ea., publications and data for installations and spares, (PR EP-0-2840-6390), $16,965,000.

X-Ray Department-General Electric Co., Milwaukee, Wis., type LD-47 camera bodies for KS-30 camera system, 49 ea., maintenance and engineering data, reproduction testing, special tooling and test equipment, for RC-130 and RB-47 aircraft, (PR MO-0-6720-12431 and amendments 1 and 2), $227,000.

General Electric Co., West Lynn, Mass., transmitters, rate of flow, type TRU-7/A, FSN 6119-6620-621-2902, Aerno 61-2495, 472 ea., and related data, for replenishment spares for B-52 and KC-135 aircraft, (PR's MA-9-05D-856 and MA-0-6620-1307), $223,-256.

General Electric Co., West Lynn, Mass., indicator, electrical tachometer, aircraft turbo speed 0-100% rpm, 2 in. size, type MU-1, FSN 6119-6620-581-2238, Aerno 61-0225, 624 ea., and data for installations and spares for F-101B, C-130B, B-52H, F-104F, KC-135, SC-130B, YHC-1B, HC-1B, HU-1A and HU-1B, (PR's ES-0-6620-6700 and ES-0-6620-6701 and amendment 1), $63,781.

Burroughs Corp., Detroit, Mich., additional facilities for support of the SAGE program, (PR BI-0-F-9135), $25,000.

Lycoming Division, Avco Corp., Stratford, Conn., development of the T55-L-5 engine through qualification to be used on the Army helicopter HC-1B (increase option), (PR 57169, MIPR R56-675-TC and amendment 14, PR 92608, MIPR R56-675-TC, partial), $1,775,000.

Aeroflex Laboratories Division, The Aeroflex Corp., Long Island City, N. Y., modification of KC-1 cameras, 2 ea., and data, for an unknown use, (PR EC-0-PI-6591 and amendment 1), $124,199.

Kuljian Corp., Philadelphia, Penn., architectural and engineering services at McClellan AFB, (PR PD-0-8-2057), $26,919.

Thomas A. Edison Industries Instrument Division, McGraw-Edison Co., Inc., West Orange, N. J., indicator, oil pressure, type MO-2, FSN 6620-714-4201, Aerno 61-2476, 620 ea., and data for installations and spares on B-58A C-133B-2, B-52H, HU-1A and HU-1B aircraft, REP's ES-0-6620-6901 and ES-0-6620-6902 (PR's ES-0-6620-6901, ES-0-6620-6902 and ES-0-6620-6995), $59,-987.

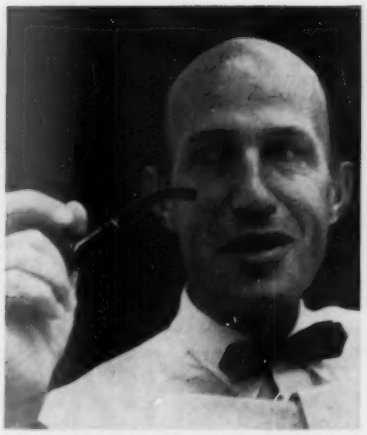
Jack & Heintz, Inc., Cleveland, Ohio, components of 20 kva, 3 phase generator system consisting of control panel, Aerno 42-0600; differential production unit, Aerno 42-0601; generator, Aerno 42-0602; regulator, Aerno 42-0603; transformer, Aerno 42-0604 for use as installations and spares for YHC-1B and HC-1B aircraft, (PR's ES-0-6115-6676, ES-0-6115-6779, ES-0-6110-6893 and amendment 1, ES-0-6115-6894 and amendment 1, and ES-0-6120-6895), $48,000.

Lambert Engineering Co., St. Louis, Mo., pods, system photographic reconnaissance, 429 ea., handbooks, drawings and spare parts documentation for S2F-1, S2F-2, P2Y-5F and P5M aircraft, (MIPR 17-60-WEPS and amendment 1), $318,950.

Abrams Instrument Corp., Lansing, Mich., intervalometers, aircraft cameras, type B-8B, Aerno 74-1004, 132 ea., spares parts and data for B-52 aircraft, (PR MO-016760-12911 and amendment 1), $139,232.

Simmon Brothers, Inc., printer, projection, vertical, manual, autofocus, type EN-52A, 61 ea., for ground support equipment, IFB 33-600-60-183, (MIPR R60-166-383-NSF), $33,550.

Westinghouse Electric Corp., Dayton, Ohio, generators, 40 kva, Aerno 42-0331, 131 ea., for spares support for B-52 F/G aircraft, PR SA-0-03C1-A11051 and amendment 1), $142,311.



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Mr. R. E. McDonald,
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Research Laboratory,
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WHO'S WHERE

(Continued from page 23)

Changes

Dr. David S. Potter, head-Sea Operations Department, General Motors Defense Systems Division, and head of the Division's newly acquired research laboratory, Goleta, Calif.

Leland C. Pleger, manager-marketing and planning, Tactical Weapon Systems Operations, Ford Motor Co.'s Aeronutronic Division, Newport Beach, Calif. **G. J. Rauschenbach** succeeds Mr. Pleger as manager of the Huntsville, Ala., office of Ford's Defense Products Group.

Asa E. Snyder, director of research, Pratt & Whitney Company, Inc., West Hartford, Conn.

Milton F. Pravda, chief of system design, The Martin Co.'s Nuclear Division, Baltimore, Md.

George P. Sutton, manager of the newly created development planning organization-research and engineering department, Rocketdyne, Division of North American Aviation, Inc., Canoga Park, Calif.

Arthur E. Linkins, director of contracts management, Stromberg-Carlson Division of General Dynamics Corp., Rochester, N. Y.

Arthur R. Taylor, manager-customer operation analysis, General Electric Co.'s Commercial Engine Operation, Cincinnati, Ohio.

Croydon H. Hartley, director of international military sales, Douglas Aircraft Company, Inc., Santa Monica, Calif., and **Russell A. Denzer,** assistant to Mr. Hartley.

William G. Carlson, director of defense and aeronautical projects, Burns and Roe, Inc., Hempstead, N. Y.

Max P. Eaton, chief of quality control, Beech Aircraft Corp., Wichita, Kan.

Virgil W. Wall, director of engineering, Electronic Systems Division, Telecomputing Corp., North Hollywood, Calif.

John V. Sigford, director of planning, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. **David C. Gerrish** succeeds Mr. Sigford as manager of the company's Aeronautical Division, Los Angeles, Calif.

N. A. Vogel, senior engineer, International Business Machines Corp.'s Advanced Systems Development Division Laboratory, San Jose, Calif.

Lloyd L. Doling, manager-Navy, Washington, D. C., office of Convair Division of General Dynamics Corp.

Roger E. Dumas, director of research and development, Inductive Products Division, Statham Instruments, Inc., Los Angeles, Calif.

Dr. Elie J. Baghdady, director of research, Advanced Communications Research Division, General Electronic Laboratories, Inc., Cambridge, Mass.

Dr. George H. Sullivan, medical director in charge of advanced bio-chemical research and instrumentation programs, Spacelabs, Inc., Van Nuys, Calif.

Lewis G. Rogers, sales manager, Industrial and Military Products Division, Bulova Watch Company, Inc., Jackson Heights, N. Y.

William L. Hill, manager of The Martin Co.'s Huntsville, Ala., corporate office.

(Continued on page 157)

Marconi's offer a complete consultancy and engineering service in the installation of radar systems. All Marconi radars and data handling equipment have been designed for integration into the most advanced air traffic control and defense systems at present in operation or contemplated in the foreseeable future.
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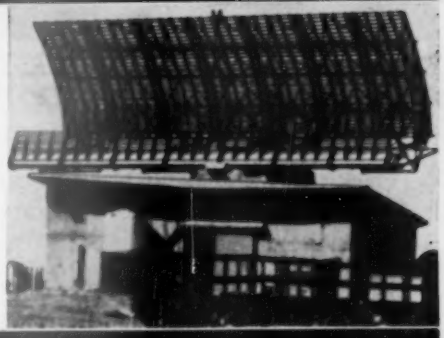

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of ground radar

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James E. Michaels, supervisor of the Astro Systems Branch, Astro Systems and Research Laboratories, Norair Division, Northrop Corp., Beverly Hills, Calif.

Irving Rutstein, engineering manager, Countermeasures Division, Loral Electronics Corp., New York, N. Y.

John M. Clampitt, director of advertising, United Air Lines, Inc.

Elmer A. McBride, West Coast district manager, General Electric Co.'s accessory power equipment for aircraft, missiles, space vehicles and marine and ground applications, Los Angeles, Calif., succeeding **R. J. Sheehan**, now manager of equipment support, GE's Aircraft Accessory Turbine Department, Lynn, Mass.

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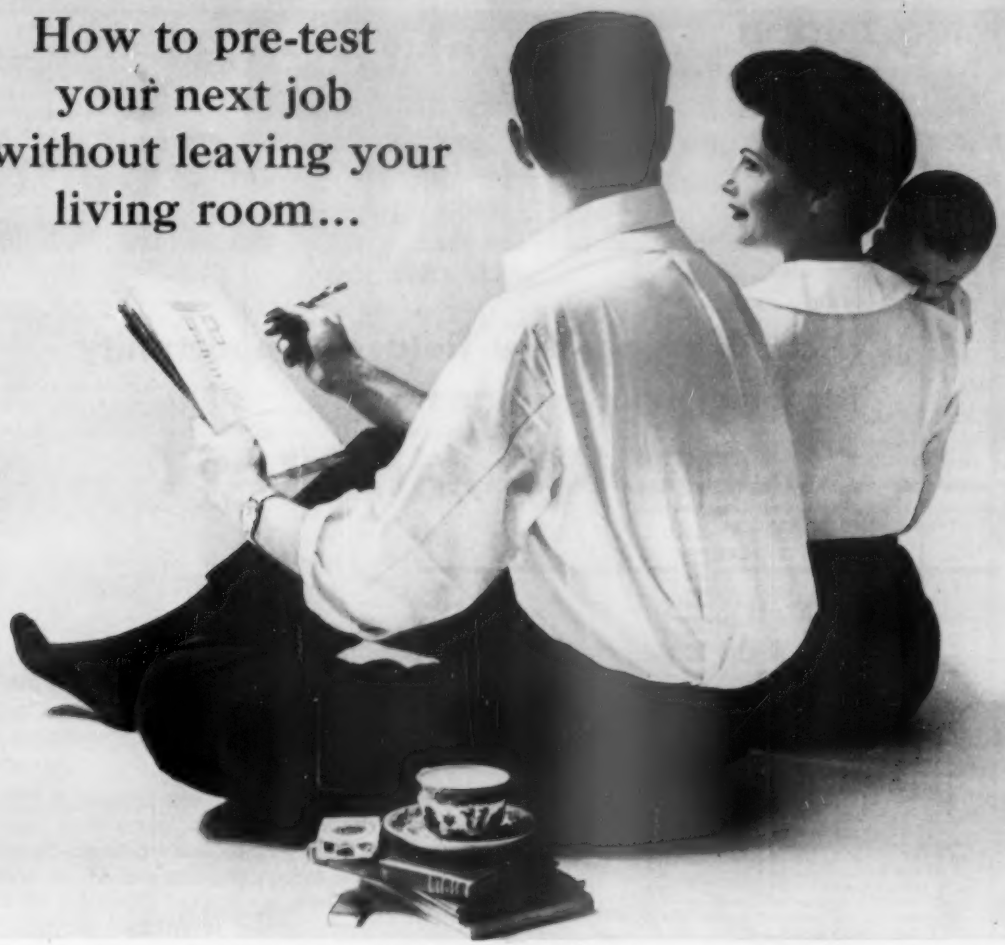

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BS or MS in Aero Engineering, Engineering Mechanics, or Physics; minimum 6 years in missile and/or aircraft dynamics. For analytical and design work in rigid and flexible body-motion areas.

BSAE or MSAE with 6 years experience in aircraft and/or missile structural analysis and design. Good knowledge of thermal stresses; heat transfer, load paths, stress analysis, strong in mathematics.

BS or MS Aero Engineering with 6 years experience in aerodynamics and related heat transfer areas. Will work in hypersonics, superaerodynamics, atmospheric dissociation. Must be strong in mathematics.

Also: Openings for similar capabilities in the one-to-three year experience range.

SYSTEMS ANALYSIS Weapons Systems analysts with BS or MS in mathematics or physics, or BSEE, to work on weapons system and component lethality, evaluations, optimization studies, feasibility studies, and concept synthesis.

All above openings are in Minneapolis area. For complete information, write Allan J. McInnis, Professional Manpower Staff, Ordnance Division, Honeywell, 600 Second Street North, Hopkins, Minn.

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H Military Products Group

To explore professional opportunities in other Honeywell operations, coast to coast, send your application in confidence to H. D. Eckstrom, Honeywell, Minneapolis 8, Minn.

LETTERS

Defense Procurement

Funding problems continue to make front page press and heated conversation among industry and government circles. It appears to this taxpayer that at least two administrative areas in defense electronics procurement should be thoroughly aired by AVIATION WEEK and be given serious consideration by your readers.

First there is the relatively high use of cost plus fixed-fee contracting. Contrary to conventional theory, this form of contracting does not provide an incentive toward efficient performance. It often results in "gold plating" of the product and "fattening" of the overhead structure. Its use should be limited to those instances wherein no amount of risk taking or imagination could be directed by either industry or the government to better perform a required task.

In all other cases, some form of fixed price contracting should be used.

I can say with a feeling of pride and satisfaction that my management bends every effort to stay within costs and to produce the best product for the least dollars. This, however, is not uniformly true in industry today.

A typical pattern is one in which the lowest bidder receives an award which later requires substantial additional funding to support an overrun. Incidentally, this overrun was probably foreseeable by the contractor at the time of award. For this contractor, the results are not all bad. For instance, there is an increase in sales. Second, there is a larger base over which to amortize his facilities. Third, there is an opportunity to do some hiring of personnel and of generally building an in-house know-how.

On the other hand, this results in a decrease in the return on investment and a dissatisfied military customer. I submit that the advantages of the former far outweigh the disadvantages of the latter in the minds of most contractors. For that reason, many companies do very little to discourage overruns while they publically disclaim them as wasteful and undesirable.

Another very serious problem is the "leaking" of information to favor contractors. Again I am pleased to say that our management does not approve of this custom. What happens is that someone in the military establishment having authority or information "leaks" to a favored contractor the fact that a specific sum of money is available to accomplish a required program.

Shortly thereafter this very contractor submits a proposal which is technically and financially responsive and acceptable. In fact, the quotation calls for funding that closely utilizes the sum of money that the agency has available for that program. The coincidence surprises no one. This practice is obviously unethical and unbusinesslike. It nevertheless is an unofficial link in the procurement cycle working to the advantage of many of the more prominent defense contractors.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

I am not pointing the finger of blame at any individual or organization. In fact, there are those such as the management of the company for which I work, who are actively pursuing the correction of deficient procurement practices. Suffice it to say that these and other inefficiencies exist and that they must be reformed.

May I point out that this is not representative of the opinion of our management. It is, thus, not a company position but instead is merely an individual expression of interest in wholesome procurement practices. It would not surprise me, however, to find that many of my associates, as well as others in government and industry, probably endorse the views set forth herein.

Please lend your support to a campaign to improve procurement practices and thereby increase the value of the defense dollar.

(Name withheld by request.)

AP 100 Powerplants

We are pleased to see illustrated in your Aug. 15 issue, p. 64, the results of much effort by Republic Aviation and ourselves on the AP 100 VTOL fighter-bomber. We would like to point out that the AP 100 powerplants are General Electric lift fans designated X353-7. These fans are similar to the X353-5 shown in your Aug. 8 issue, p. 94, but tailored to the supersonic fighter-bomber application.

W. L. RODENBAUGH
J. P. SIMON
Applications, Systems & Performance
VTOL
Flight Propulsion Division
General Electric Co.
Cincinnati, Ohio

Pilatus P.3

I've been reading AVIATION WEEK since 1947 and have always enjoyed reading it. The Business Flying section has always held the most interest for me.

Your caption writer in your Business Flying section should take a course in aircraft recognition. That aircraft he called a Ryan Navion in the caption under the photo on p. 137 of the Aug. 15 issue is actually a Swiss Pilatus P.3 tandem basic trainer powered by a 260 hp. Lycoming engine.

Keep up the rest of the good work and let's have more Business Flying news.

Frank Strnad
American Aviation Historical Society
Northport, N. Y.

(Mr. Strnad is correct. The aircraft shown is indeed a Pilatus P.3.—Ed.)

Variable Camber Prop

Since we are presently making final preparations for flight test of the Navy's K-16B VTOL airplane utilizing our own version of variable camber propellers we were most interested in Barry Tully's "Variable Camber Prop Studied for VTOL" (AW Aug. 15, p. 98).

The Hamilton Standard approach to variable camber is an interesting idea. The use of a dual propeller system to achieve high thrust seems worthy of thorough investigation.

Our own work with variable camber propellers started in 1956 at Bradley Field, Windsor Locks, Conn.—two years before Hamilton Standard—with full-scale tests of ideas conceived some years earlier. (Bradley Field is also the site of Hamilton Standard's facilities.)

The propulsive rotor, combining for VTOL the functions of an airplane propeller and a helicopter rotor, which is used on the Kaman K-16B Navy VTOL aircraft, was designed with a buried flap to achieve both variable camber and cyclic pitch control. We cannot be certain that ours is the first variable camber propeller; but we are sure that our approach to variable camber was conceived and developed solely by Kaman engineers.

Full-scale propulsive rotors have been extensively ground tested. They are presently installed on the K-16B aircraft now entering tie-down tests.

The .5 chord, .5 span flap on the Kaman propulsive rotor has approximately 83% of the aerodynamic effectiveness of an equivalent full-span flap but with substantial improvement in structural design characteristics.

The Kaman propulsive rotor also has lead-lag and flapping hinges similar to those common in helicopter rotors. Our 15 years' experience with rotor and servo-flap design possibly made us less apprehensive of the problems Mr. Tully says were anticipated by Hamilton Standard. Our test stands have demonstrated the practicality and advantages of variable camber achieved by an integral flap system.

We agree with Hamilton Standard in their anticipation of the potential of high thrust or variable camber propellers for VTOL aircraft. We believe further that cyclic control is an additional necessary element. Previously flown VTOL's have established that today's powerplants and aeronautical science have made it possible to build aircraft other than helicopters that are capable of vertical takeoff and forward flight, but we believe more adequate control during hovering and low speed flight must be demonstrated.

To date, full-scale tests substantiate that the propulsive rotor will provide significant improvements in both thrust and control for VTOL aircraft.

JOHN O. EMMERSON
Vice President-Engineering
The Kaman Aircraft Corp.
Bloomfield, Conn.

LFE

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in Electronic Warfare

The simple game of Tic-Tac-Toe demonstrates problems of electronic warfare. The solutions to these problems, however, are not simple.

For over ten years, a major LFE activity has been the development of techniques to maintain the effectiveness of radar and other electronic devices, despite enemy countermeasures.

LFE correlators and discriminators, frequency diversity and multiple beam scanning techniques encompass the full range of airborne, shore-based and underwater applications.

We invite your inquiries. Please write Dept. P1-17 or the International Division.

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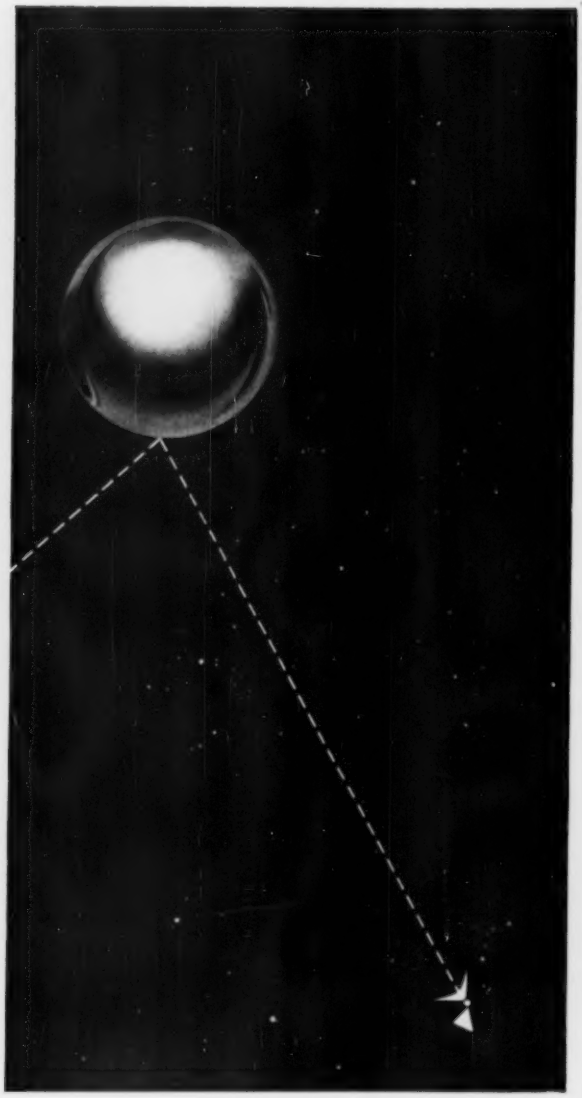

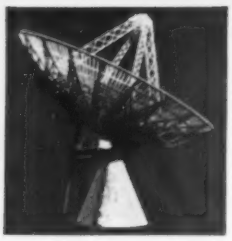

Project "Echo"—using a passive, 100-foot diameter, inflated sphere orbiting the earth to reflect signals—is investigating the feasibility of reliable and efficient long-range microwave communication. Radio and voice signals were bounced off the sphere between California and the East Coast. This followed earlier successful "moon-bounce" signalling between the same locations using the same transmitter.

Varian was contracted by the Jet Propulsion Laboratory (JPL)* to develop the unique klystron amplifier system built right into the 85-foot diameter parabolic transmitter antenna. To assure maximum success in "echo transmission," the system was designed around the proved and reliable Varian VA-800 C Klystron, to provide 10kw output at the desired 2390 megacycle frequency.

*Jet Propulsion Laboratory, a research and development facility of the NASA

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